Civil Engineering Education.

DISCUSSION.

(*Continued from page 38*).

Extract from a letter by G. Bouscaren, C. E.

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The first requisite of an engineer is accuracy. I am sorry to say that, within my personal experience very few graduates possess this quality, not from the want of natural ability generally, but from the fact that they never acquired the habit of checking their work. This faith in the infallibility of the mind, works disastrously in an engineer's office.

"Error is the rule, truth the exception." These words should be written in epigraphic form in all lecture and study rooms of engineering students, they should be taught that the simplest operation should be proved before accepted as correct.

I do not see in Professor Waddell's curriculum any mention of methods of approximation as applied to the ordinary practice of engineering; this is certainly a great desideratum for the training of the judgment of the average young man who reads his rod to the $\frac{1}{100}$part of a foot on rough sloping ground and neglects to check his bench, and who is content with an unverified assumption of load on a structure, but will carry out the stress on each number to a fraction of a pound.

The majority of American graduates are very deficient in the art of draughting—wherein they stand in dreaded inferiority to their European brethren, who for this reason only will often beat them in the race for positions. It is a great error to suppose that the introduction of the heliographic printing process has much decreased the demand for good draughtsmen. This printing simply saves the time and labor of "tracing machines," but it does not design details or produce the carefully drawn graphics which should always serve as a proof for analytical calculations.

Although proficiency in draughting is not indispensable to the success of an engineer if otherwise well gifted, it is an advantage which he cannot afford to throw away and which should be given by all good technical schools.

BY WM. H. BURR.

My contribution to the discussion of Professor Waddell's paper should rather be termed a discussion of his subject; as some of the general characteristics, only, of what seems to me to be the engineering education best adapted to the present demands, will be considered.

A close observer of the present condition and requirements of the "profession" of civil engineering cannot, I think, fail to conclude that the schools now existing under that name do not supply some of the higher qualifications frequently required in engineering practice. A very few schools offer fair opportunities for the acquisition of the purely technical portion of the education under discussion, but they are utterly without that broad and general training which, in after life develops into influence and power over *men*.

The difficulties which surround the proper organization of such a school of civil engineering in this country are neither small nor few, although, as will presently be seen, means are at hand for the effectual remedy of at least one great difficulty.

In the first place, there must be educational institutions, in which young men may be prepared in the more elementary portions of those mathematical and physical lines of study which are to be more extensively developed and pursued in the various ramifications of technical application in the school of civil engineering. Again, in these schools, preparatory or introductory to the advanced technical establishment, there should be found complete courses in the science and use of languages, and kindred subjects, which constitute the humanities of an ordinary college course. In order that a civil engineering school may be organized for the best practicable results, and at the same time fall short of being purely ideal or Utopian it is not too much to say that such introductory institutions should be available—and, indeed, they are available.

A few young men yearly already possess the wisdom to first take a college course of study, and subsequently devote their attention to the school of civil engineering. This is motion in the right direction, and indicates that the conditions are even now favorable to the highest attainments in technical education. It has thus begun to be perceived, that not only the higher success in civil engineering is not to be reached by a purely technical training but, also, that the best engineering education is to be based on, and preceded by a thorough training in those general subjects which cultivate and expand the intellect, and give a young man the broadest base and surest foundation for the subsequent structure of his after life.

It must be carefully borne in mind that a successful engineer is not only a sucessful technist but, also, a successful *man*, and a successful man is one who in his business and other relations controls men. The inception, development and culmination of an affair involving engineering work, may truly require the most complicated and subtle application of technical knowledge, but unless the engineer is simply an employé paid to exercise his art as a technist only, he must be cultivated in those accomplishments of intellect and address, which shall give him power to sway the minds and judgments of those about him to his particular purpose. In the first case he attains, it is true, a most creditable success in his specialty, but in the second only, is he a principal, and does he attain success as professional engineer.

The highest type of civil engineering education, therefore, is one in which the broadly cultivated intellectual powers operate on, and assimilate technical knowledge to the end that the individual may not only convert the powers of nature to the use of man but, also, convince man of the utility of nature, *i. e.* it should fit him to move both man and nature.

The better colleges with fixed and not elective courses may answer tolerably well the purposes of the schools preliminary to that of civil engineering. They, however, go too far in some respects and not far enough in others, so that unless a young man is well directed and advised, he will fail to get enough of physics and mathematics and too much of the dead languages. Not that I think the latter should be ignored, but that the student ultimately destined for civil engineering can best confine himself to Latin alone. A good knowledge of that language will give him greater power over his own and render his acquisition of at least one important modern language easier and more thorough, besides incidentally conveying to him some historical knowledge, which will form no contemptible portion of his general education.

With the purpose of indicating the availability of the colleges of this country in the best scheme of technical education, I suppose them to supply elective courses, which many of the best are already doing. In such a manner, and in such only, can they perfectly and most admirably supply the required educational training preliminary to the technical school. All time ordinarily prescribed for Greek should be devoted to the most careful and thorough extension of the mathematics and physics found in ordinary college courses. In this manner, advanced or higher algebra and analytic geometry, as well as the elementary portions of descriptive geometry would be completed with the end of the student's college work. An excellent foundation would be laid in heat, electricity and magnetism on which would afterward be founded advanced technical courses. Light and sound being less essential to the civil engineer would be finished at college. Some fundamental notions in chemistry should also be given. The complete college curriculum so far as all English subjects and the French and German languages are concerned, should be most scrupulously adhered to, since these form, or should form, the immediate, if not main purpose of the student's time at college.

If a young man can by any possibility spare the time and means, four years should be devoted to this preparatory season. If any misfortune prevents this, the omission of Latin and partial or complete curtailment of either French or German will enable him to complete this preliminary work in three years without directly or immediately impairing his technical preparation. Only the direst necessity, however, should induce him to thus reduce his general education, and he should improve every possible opportunity to subsequently repair the loss.

This simple and very incomplete sketch outlines a field of the highest usefulness for the modern elective college curriculum. Among its most important possible results not one is greater than its preparation of the technical student for his technical school.

No student of civil engineering should enter the elective college under sixteen years of age. He would then reach his technical work preferably at an age not less than twenty years, or with the curtailed elective course at the age of nineteen years, and thus begin the study of civil engineering proper with a fixed purpose and habits of work settled both by discipline and advanced years as a student. His college experience would give him such facility of analysis and power of comprehension that both the quantity and quality of his subsequent technical work would be greatly increased, while the breadth of his preparatory training would in all cases completely counteract any narrowing influence of his purely technical study and investigation; and there now only remains to determine in a general way what that shall be. I believe Prof. Waddell has in the main most admirably settled this part of the question. In continuation, however, with what has preceded I would limit the course in the civil engineering school to three years and place many of his first year subjects in the elective college course; such, for example, as Analytic Geometry and Natural Sciences. In the writers opinion, also such subjects as Mining Engineering, Mechanical Engineering, Electrical Engineering and Ship Building should be omitted from a course in Civil Engineering, as here contemplated, as not sufficiently germane to the subject. It is believed the same may be said of Foundry Work and Pattern Making as well as Architecture, unless the latter be composed of some very fundamental notions which would enable the engineer to utilize properties of materials and constructive principles so as to produce outlines of good engineering structures, and features of sound construction, without violating the canons of good taste.

It would certainly be useful for a civil engineer to be familiar with the subjects just criticised, but he is human and correspondingly limited in his capacity to work, and in these times of specializazion he cannot practice as a universal engineer. He will find it sufficiently difficult to perfect himself as a civil engineer, and he should concentrate all his technical efforts in that direction.

It is also a very grave question how far shop-work should enter the course in civil engineering. It is certainly true that such a course of study may be founded without a trace of shop-work in it, and yet be productive of excellent results, for actual test has demonstrated the fact. No civil engineer needs facility in the use and manipulation of tools and machines, or in foundry work and pattern making, but he should understand their *capacity*. Whether actual experience in shop-work is necessary to enable an educated and intelligent man to determine what shapes for an intended purpose can be most economically produced or, sometimes, produced at all, may possibly be a matter of opinion, but I am confident that experience is not necessary. Proper lectures on the use of tools and machines, illustrated and enforced by constant references to models and drawings of metallic structures showing the members shaped and surfaces finished by them, together with frequent and careful studies of the same tools and machines at work, not on models or specimen pieces but on actual members in process of production in accessible shops and foundries, will supply just the knowledge of these principles, both in quantity and quality, which properly govern design. While I am aware that clinical lectures of the mechanical kind are not in some quarters considered of much value, I am confident that these careful and well directed shop observations, supplemented by proper lectures, are productive of every desired result.

With the modifications just indicated and with the purely technical part of Professor Waddell's curriculum applied to a three years' course supplementary to the elective college work covering four years, I should consider this civil engineering study extending over seven years no more complete than professional requirements now demand. A young man would then be ready to begin his practical life at the age of twenty-three years, which is but little, if any, in advance of the average age of the graduates of one or two of the best of our technical schools.

It may be objected that the preceding scheme is too elaborate, that the great body of average young men cannot be expected to attain to such a high professional grade as is contemplated in this broad and extended scheme of education. All of which I admit, and more. But it is undoubtedly true that the highest success in civil engineering, as now constituted, demands even more of an educational foundation than that here outlined; and it is equally true that a complete technical course of study should be so designed as to develop the best men in the best possible manner. In the midst of such general excellence, the average man, by the force and example of his environment, will be brought to the highest possible stage of development; much higher, in fact, than in a system of less general merit. Again, with such an admirable educational system, the responsibility of failure rests not with the institution but with the individual.

Let it not be supposed, however, that I for a moment imagine the result of such a course of study is the finished civil engineer, who is really the product of ability and adaptability combined with years of experience based on the broadest and best educational foundation.

For this reason I can scarcely command language strong enough to condemn the present practice of conferring the degree of "Civil Engineer" at the end of a frequently and usually meager course of study. Whatever may have been the intent in its origin, in its present practice it is almost universally little else than a bid for patronage. Certificates vouching for the amount and quality of work done, may with propriety be given at any point in the course, but the degree of "civil engineer" should only be given after the satisfactory completion of the entire course of study, supplemented by at least two years of actual experience in engineering work and on the presentation of a creditable thesis.

The organization and administration of such a three years' course in civil engineering as has been outlined, may be satisfactorily completed in a number of ways, and it will be advisable to touch on some main features only.

Whether the corporation should be "The President, Fellows, etc.," or "the President and Trustees, etc," is of little matter, but it is of vital importance that there should be no "one man power" about the educational part of the establishment. Among all vicious features, a self constituted autocrat with little greatness and great littleness probably stands pre-eminent, and such a millstone about the neck of a worthy institution is not unknown. Able men with strong character, competent to fill a professorships, and with a corresponding amount of self respect, need not and will not quietly serve under such circumstances. As an inevitable consequence, lack of harmony or vacant chairs will result; and both are highly objectionable.

The head of the faculty may possess the veto power, but he should use it with the greatest discretion. In other respects, so far as the curriculum and educational discipline are concerned, he should simply be the executive officer of the faculty. There should be frequent stated meetings of the faculty at which heads of departments should vote and the result should be final. Lectures, recitations and examinations should be conducted in the broadest possible spirit. So far as the methods of instruction are concerned little need be said, for if an instructor is competent to fill a chair in a faculty of civil engineering, methods may safely be intrusted to him. If such responsibilites are not safe in his hands he is unfit for his position and should be promptly displaced in favor of a competent person. The same effective measure of reform should be applied if by any unfortunate appointment a chair is found occupied by an instructor who allows his whims, his narrow ideas, or worse yet, his spite, to govern his ordinary exercises or his examinations. This evil is by no means imaginary and it is known to exist in connection with mistaken ideas which restrain the proper authority from exercising its remedial power of removal.

"Fellows or Trustees" should understand that the educational discipline of the institution and details of the course of study can only be effectively reached through the faculty; hence their direct interference will inevitably bring disorder and almost as inevitably increase the difficulty intended to be remedied. It is their duty to see that proper men are in the faculty to conserve such matters, and to remove without delay such as are disinclined to discharge the duties and responsibilities of their positions.

Municipal Engineering; Paper No. 4.*

PHILADELPHIA, PA.

(*Continued from page 40.*)

Crossing Stones.—On account of the inferior pavement, crossing stones have been placed on the line of almost every sidewalk in the built-up part of the city, generally flagstone 16 or 20 inches wide, in two lines. On the principal shopping streets crossings are also laid between intersecting streets, at intervals of about 100 feet, and the crossings at intersections are much wider—three or four lines of 20 or 24 inch flags with one to three courses of paving blocks between adjacent lines. Since the laying of granite block pavement, however, crossing stones are being less used and are more commonly of granite. The specifications for 1885 require them to be not less than 5 or more than 8 inches in thickness, not less than 4 feet in length, and in widths of 16, 20 and 24 inches. 20 inch granite crossing stones cost 74 cents and 16 inch, 65 cents per running foot in 1885.

Roof Water Disposal.—The common practice in streets having no sewers (and also to a great extent in streets having sewers,) is to run roof water over or under the sidewalk into the street gutter, either through a shallow channel in the brick or stone, or a rectangular iron conduit, or iron or terra cotta pipe. In the better class of new houses it is usually connected with the general drainage of the house, frequently without a trap before the recently assumed supervision of house drainage by the Board of Health.

Street Sprinkling.—With the exception of a small portion of Broad street (by contract) no street sprinkling is done by the city. Private parties, paid chiefly by the business houses in the heart of the city, do what little is done. No special form of cart is used; they are generally rectangular with the bottom sloping to the rear, cylindrical or barrel shaped. Water from hydrants is furnished for sprinkling free by the city, but the parties must take out permits and give bonds of $300 to cover repairs of damages to hydrants.

Street Cleaning.—From 1869 to 1881 the Board of Health had charge of the street cleaning of the city. At the close of the latter year it was transferred to the Chief Commissioner of Highways. As before, it is still done entirely by contract, and includes the cleaning of sewer inlets and market houses, and removing ashes and dead animals. The city is divided into fourteen districts each of which is contracted for separately every year. Following is an

Abstract of Street Cleaning Specifications.

The work "shall be prosecuted regularly throughout the year except during continued stormy weather or when the ground is covered with ice or snow, or the dirt is so frozen that it cannot be scraped or swept." In winter the weather is usually such as to prevent (under this exception) general operations for a month or more at a time (last winter nearly three months). At such times, however, "all street crossings, city inlets [to sewers], gutters approaching the same and all gutters necessary to drain crossings within 100 feet of inlets, and all fire-plugs for a radius of 5 feet and out to the beaten track, shall be kept clear of ice and snow."

Streets in the principal business portion—Arch to Walnut and Front to Fifteenth, inclusive—shall be cleaned once each day, except Sundays, and in the principal streets in the above area the work shall be done between 6 P. M. and 8 A. M. from May 1 to December 1. The remainder of the built-up portion shall be cleaned two or three times a week (the greater portion only twice) and the rest of the city once a week, twice a month and once a month, as specified.

"All public market houses shall be swept six times each week, and, whenever frost does not prevent, shall be scrubbed with water not less than twice each week, immediately after market hours," and all highways contiguous to public, private, curbstone or huckster markets shall be cleaned six times a week.

Footways on bridges when dangerous by reason of ice shall be sprinkled with sand or ashes from which all coarse material has been removed.

Sewer inlets shall be cleaned not less than twice a week, on streets which are cleaned more than twice a week, and in other cases as often as the contiguous streets. Inlets receiving drainage from market houses, or market stands, shall be cleaned not less than twice a week. All inlets shall first be examined to ascertain if they are properly trapped; if not, the fact must be at once reported to the Highway Department, as also any other defect in their condition or construction. Immediately after cleaning, water must be run in, and the trapping made complete. In dry weather all inlets shall be examined not less than twice a week, "cleaned, if necessary, and more water added if needed to complete the trapping." All gutters "that may be kept wet by the continual flow of filthy water or sewage shall be, from the 1st of June to the 1st of November, scraped, brushed out and thoroughly cleaned (with water, where water is obtainable from fire-plugs) twice each week," and from November 1st to June 1st once a week, except when prevented by frost or storm.

"Whenever the highway is in a condition such that sweeping will cause dust to rise, it shall be evenly sprinkled by sprinkling wagons." Sweepings and mud shall be removed in tight carts within three hours after being gathered in heaps.

All ashes, sweepings and cut grass in receptacles weighing (with contents) not over 100 pounds, and in quantities not exceeding three barrels a week for tenement, that are placed on the sidewalks of streets (or alleys traveled by wagons) shall be collected and removed once a week, on regular days and at regular hours, without spilling the same on sidewalks or cartways, and without injury to the receptacles. When the streets are blockaded by snow, they shall be removed by carrying or hauling on sleds to carts in streets that can be traveled. The contractor shall serve cards or circulars giving his name and address, and stating the days for collection in each street or section, at every building, every ninety days. Ash wagons shall be tight, and covered when in motion, and half covered when loading, with cover fastened to the cart. "Ashes, dirt, or rubbish made in the prosecution of any manufacturing or building operation, or by or for the use of any steam engine or boiler, and deposited in or on any part of the cartway, shall be removed, but the cost may be collected from the proprietor."

The contractor shall "keep on the work for daily use, in each district not less than 100 feet of fire hose for flushing gutters and inlets. All solid matter must be removed from gutters and inlets before they are flushed."

"Contractors shall within ten days of award of contracts, deposit with the city solicitor real estate security in half of the amount of their contracts, and deposit in cash with the city treasurer 10 per cent. of the amount of their contracts." Failure at any time to fully and faithfully perform the work in accordance with the specifications, will authorize the Chief Commissioner to have the work done (without notice to the contractor) and pay for it out of the contractor's security, and also deduct from his pay a like sum as penalty, or instead of that (at the Commissioner's option) $3 a day for the time of neglect for each article of the specification violated.

The above is an abstract of the street-cleaning specifications for the present year. Those for 1885 required the use of "the most improved machinery" in the built-up portions, and sweeping machines were used on most of the principal streets that are paved with Belgian blocks. But this is not now required and no machines are used. Birch whisk brooms and long handled hoes, chiefly in the hands of Italians, are the principal tools.

Except in the principal streets, the sprinkling is generally done with large watering cans (filled from the hydrants) or with long-handled, flat-bottomed scoops from the gutters.

The specifications make no mention of the disposal of sweepings and ashes. They are hauled (separately except in wet weather, when the ashes are mixed with the semi-liquid mud to give it consistency) to the nearest dump, on the line of some ungraded street requiring filling.

Following is a summary of street cleaning operations during the last eleven months of 1884. (So little was done in January that no account is made of it.)

Number of days' work sweeping and scraping..	64,671
Number of days' work, carts and wagons.....	82,217
Number of days' work cleaning inlets.....	6,187
Number of days' work removing snow and ice	2,279
Number of loads of ashes removed.....	290,018
Number of loads of street dirt removed.....	252,396
Number of inlets cleaned.....	73,743

The quantity contained in an average "load" is probably a little under 2 cubic yards. The above figures are compiled from the daily reports required of the contractors. The amount

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of the street cleaning contracts in 1885, was $239,641, and in 1884, $225,441.

Garbage Removal.—The removal of kitchen garbage and offal is also done by contracts made with the Chief Commissioner of Highways each year. The city is divided into the same districts as for street cleaning. "Householders shall deposit their kitchen garbage and offal in water-tight vessels that can be easily and quickly lifted, handled and emptied by one man." Each garbage collector shall supply himself with a large water-tight bucket, frequently calling out "Slop!", ring or knock at the entrance of each house or tenement, and give not less than three minutes time thereafter for a response or the right to enter and collect garbage." Garbage shall be collected in the months July to October, inclusive, six times a week, from April to June, and in November, four times; and from January to March and in December twice a week.

Complaints are numerous that this service is not well performed. In winter it is largely given up by the contractors to volunteer collectors and fed to swine within the city limits. As hot weather returns the Board of Health banish the pig-sties and the contractors remove it just outside the city. The sum of the contracts for garbage removal in 1885, amounted to $22,074 and in 1884 to $23,106.

Street Obstructions.—Permits are required from the Highway Department for occupancy of a portion of a street by building material in the erection or repair of buildings. The dimensions of the space allowed are not to exceed 80 feet in addition to the length of front, or 9 feet in breadth. Building materials must not be placed within 4 feet of a fire-hydrant or crossing, or within 1 foot of the curbstone, nor shall a sidewalk be obstructed except by temporary enclosure as a safeguard while tearing down buildings. Platforms 10 feet above the sidewalks and of sufficient strength to intercept falling bricks or other material are required in front of buildings in course of erection or repair.

The following are declared to be nuisances:

"To set up or maintain any fence beyond the building line, or any railing, except around excavated areas now existing, so as to reduce the footways of streets 100 feet and over in width to a width of less than 16 feet; of 80 feet streets to a width of less than 14 feet; of streets of 60 feet in width to a width of less than 12 feet; of streets of 50 feet in width to a width of less than 10 feet, and of all streets of a less width than 50 feet to a width of less than 8 feet; or to project any bulk-window more than 1 foot into the footway beyond the building line."

"To place or pile any empty boxes, barrels, hogsheads, or crates, on any footway or highway of the city."

"Signs suspended across the footways from awnings shall be properly fastened, and not less than 8 feet from the sidewalk in height, and swinging signs projecting from buildings shall not extend more than 5 feet from the building." (The latter clause is frequently violated.)

"To transport, or carry through the streets of the city, in any dray or other vehicle, any iron or other metal, in bars, rods, sheets, strips or in any other form, in such manner that the same shall project or extend beyond the line of the hubs of the wheels of such vehicle, unless the iron or metal so transported or carried, shall have the ends thereof covered with a board framing."

"To suffer or permit snow to remain more than six working hours after the same may cease to fall, on any paved footway or gutter of the city in front of or adjoining any church, public building, house, store, shop, stable, or tenement of any kind, or the adjoining side-yard thereof, or vacant lots."

"To use any wheelbarrow or handbarrow or handcart upon any of the paved footways of the city, except before eight o'clock in the morning from the twentieth day of March to the twentieth day of September, and before nine o'clock in the morning the rest of the year (except however when the depth of snow in the streets or other unavoidable causes render the passage thereon impracticable), or to load any such vehicle in such manner that the load or burden shall extend in width more than 4 feet from the extreme points of such vehicles, or to occupy any portion of the footways as a stand for such vehicles."

"To saw or cut any wood, or pile or place any wood, bricks, stones, boards or other lumber, or any shavings, ashes, kitchen offal, dung, or filth, upon any footway in any public street."

TO BE CONTINUED.

Johnston's Hydraulic Pump.

Mr. David Johnston, of Glasgow, claims to be able to pump water from mine workings "for nothing," provided that sufficient water can be caught at from twenty to thirty fathoms above the surface of water to be pumped. This he accomplishes by his hydraulic pump, of which Fig. 1 shows a vertical longitudinal section, and Fig. 2 a plan. A is the hydraulic cylinder, B the pump barrel, C C C casings, tied together by bolts, and thus completing the cylinder and pump barrel. These latter consist simply of flanged tubes, easily bored and readily renewed when worn. D is the working piston and D^1 the pump plunger. F F are the main valves of the hydraulic cylinder, being a combination of the piston with the clack, and giving the free action of the former with the tightness of the latter. The two levers L L, and rods R R, work the small piston valve which actuate the main valves of the hydraulic cylinder. These levers are worked by their heels being pushed by the short rods passing through stuffing-boxes in the outside casings of the pump barrel and hydraulic cylinder, one of them terminating in a handle for hand working on starting. S is the suction, and O the discharge passage of the pump, the latter also taking the exhaust water from the hydraulic cylinder. In another form of this pump Mr. Johnston replaces the rods and levers by small pipes, one of them connecting the pump barrel with one side of the small supplementary valves, and the other the hydraulic cylinder with the other side of the valves. On one side the water under pressure in the pump barrel

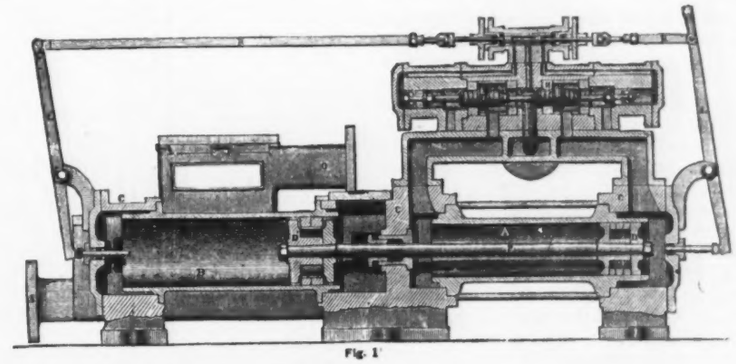


Fig. 1.

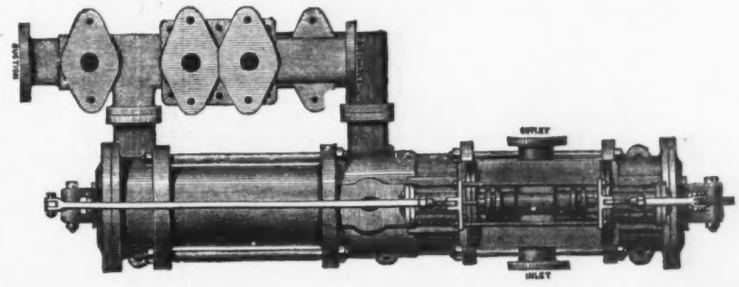


Fig. 2.

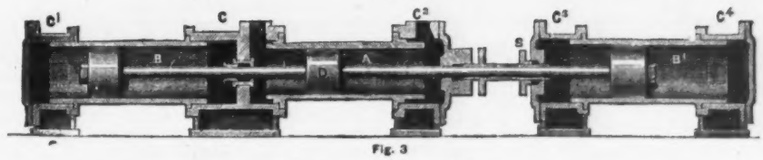


Fig. 3

Johnston's Hydraulic Pump.

moves the small valve, and on the other a continuation of the piston-rod acts as a piston for forcing water up to the outside of the small valve.

Fig. 3 shows an arrangement for pumping out shafts or workings while in progress—that is to say with, the resistance increasing. A is the hydraulic cylinder of 6in. diameter, with pump barrels B and B^1, of 7in. diameter, one on either side. C, C^1, C^2, C^3, and C^4 are the casings connecting the bored tubes, and D is the working piston. Such an arrangement, with a head of 100 fanthoms, capable of pumping water from a vertical depth of 100ft. Suppose, however, this depth to be exceeded, and the resistance to equal the power, all that has to be done is to change the place of the 9 in. with that of one of the 7in. tubes, the flanges of both being made similar, thus increasing the power by one-half. At S is shown a new stuffing-box, the gland of which has a long tube, projecting into the chamber of the pump barrel B^1, through the stuffing-box S; but

there is no friction in the stuffing-box, as it is outside the tube, so that no motion takes place through the packing. The tube may be pushed into the pump chamber for re-packing the stuffing-box or the piston D.

Both forms of pump—one in which the valves are worked by levers, and the other in which they are worked by water under pressure—are put down at the Bredisholm Colliery, owned by the Provanhall Company, with a head of 145 fathoms. The former has a hydraulic cylinder of 5½in., giving an effective area of 21 square inches. The piston-rod comes through both ends of the cylinder, and is coupled directly to a 9½in. double-acting pump at one end and a 7in. ditto at the other, the stroke being 20in. The combined area of the two pumps is 105in.; but, as the exhaust water of the hydraulic cylinder is discharged into the delivery pipe, the total pumping area is 126 square inches.

The discharge is carried by a 6in. pipe and several 4in. bends for a distance of 80ft. with a rise of 10 ft, and is put in communication with an 8in. column 72ft. high. The suction pipe, 5in. in diameter, extends about 100ft. from the pump with a fall of about 14ft.; and the water for supplying the hydraulic cylinder is led, in 3in. and 1½ in. pipes 1650ft. long, from the surface to a filter, for removing particles suspension which would cut the tube and valves. At a speed of 26 strokes a minute, which cannot well be exceeded, owing to the throttling of the supply and the pressure on the delivery pipe, the consumption of water is 39 gallons, and the delivery 195 + 39= 234 gallons per minute. To test the efficiency, a 1000 pounds pressure gauge was put in communication with the hydraulic cylinder, a 200 pound pressure gauge with the delivery passage of the pumps, and a vacuum gauge with the suction pipe, when it was found that at 26 strokes per minute, the pressure on the cylinder was a maximum of 350 pounds per square inch while the piston was traveling, but 414 pounds when there was no motion; that on the discharge there was a minimum of 42 pounds per square inch, but jumping up to about 60; while the vacuum gauge vibrated from 12 to 18in. The area of the two pumps, 105 square inches, added to that of the piston, which discharges the water of the hydraulic cylinder into the delivery pipe, gives a total area of 137 square inches, which multiplied by 42, due to the head and resistance of the discharge pipes, as shown by the gauge, gives a total back pressure of 5292 pounds and this, added to the 6 pounds per square inch shown by the vacuum gauge, into the area of the pumps—105 square inches—gives a total resistance of 5927 pounds. The area of the cylinder—21 square inches—multiplied by the effective pressure—350 pounds—as shown by the gauge, gives a total effective pressure on the piston of 7350 pouuds or 80 per cent. of useful effect. By breaking only one joint, the valve chamber, with the two pairs of valves, may be removed and sent up to the surface for examination or repair, leaving all the heavy parts at the bottom of the mine; nor is it necessary that the valves be attached to the engine. Where the pump is required to work in an inaccessible position, or where there is danger of water rising, the valves may be placed in a convenient place, and connected by a couple ofpipes with the hydraulic cylinder. —*The Engineer.*

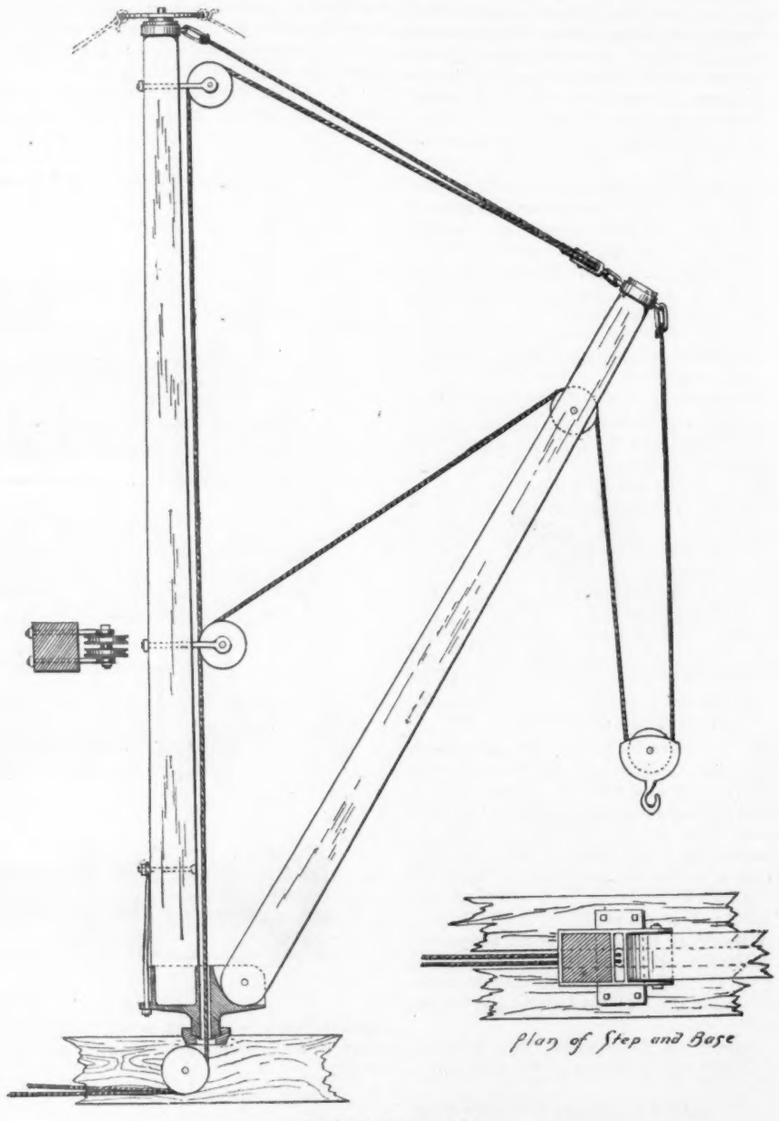
A Contractor's Derrick.

We illustrate in this issue a contractor's derrick, for which letters patent have been granted to Patrick Kelly of Poughkeepsie, N. Y., and which has practical merit sufficient to recommend itself.

The cut hardly needs explanation to those who have use for this item in a contractor's plant. The essential features are a simplification of construction and increased convenience in use. This is secured as follows:—The hollow socket and base plate differ but slightly from those already used but the stepping of the mast and the disposal of the topping and hoisting falls are new departures practically.

As will be seen the axis of the mast is not in the center of rotation, but to one side of it as shown. This arrangement does away with the boring of the mast through its heart and the usual attachment of the sheave leading out to the hoisting-fall on the boom. Two sheaves below, one an idle pulley, and one other above, are attached to the mast by simply boring holes for the reception of the holding-bolts. Both mast and boom can be left in the squared stick if necessary, and their fitting is so simple that the irons of this derrick are all that require transportation even though the distance be short from point to point of use. The labor to be expended upon the timber portion is almost nil.

Nothing more need really be said, save that very considerable experience has proved the good qualities mentioned.



Contractor's Derrick.

Regulations for the Engineering Department of the South Pennsylvania Railroad during Construction.

(*Continued from page 41.*)

V. Structure Plans.

1. The Chief Engineer will cause standard drawings of the road formation and ordinary structures to be furnished to each Division Office. Division Engineers shall supply duplicates of these drawings to their Resident Engineers, as needed.

2. Division Engineers shall cause necessary modifications to be made in masonry plans to adapt them to various localities, altering the flare or length of wing walls, for example, to fit irregular ground, skewing for oblique channels or roads, sizing for heights intermediate to those provided for in the standards, and the like; but the elevations and square widths of bridge seats shall not be altered except by warrant from the Chief Engineer or his Associate.

3. Special instructions will be given, as to structures on steep inclines and skew openings, sharper than forty-five degrees from the center line.

4. Plans modified by Division Engineers, and also the standard structures which they

propose as being anywhere suitable, shall have the approval of the Chief Engineer or his Associate before the work is laid out.

5. Where special structures are required, such as viaducts, large bridges, or other exceptional work, not provided for in the standard plans, the Division Engineer shall cause the ground to be surveyed and mapped to 5 feet contours; scale, 10 feet to an inch, with corresponding profile, and submit the same, accompanied by illustrative notes and such suggestions as he may think proper to add, to the Associate Engineer, who will, thereupon, cause a plan to be made, or give orders for its making to the Division Engineer. Exhibits of this kind should include high and low water marks, character of bottom or sub-soil, and in the cases of road-crossings, a profile of the same for 500 feet each way.

6. All plans of railroad buildings shall originate at the Central Office, and copies thereof will be furnished by the Chief Engineer or his Associate, with suitable instructions, to the Division or Principal Assistant Engineer charged with their erection.

7. Copies of all plans prepared by Division Engineers for their Residents shall be preserved in the Division Office.

VI. Field and Office Records.

1. Resident Engineers shall prepare a series of cross-section drawings, including the tunnels of their respective Subdivisions, in bound books of uniform size furnished for that purpose, showing the original surface of the ground as widely as observations extend, the slope staking for road formation, the staking for incidental excavations, the proposed formation lines, and the computed quantities before grading, in India ink; copies, or written abstracts, of which cross-sections they shall transmit to the Division Engineer from time to time as they are made, marked with the name of the Division and other distinguishing particulars.

2. On the completion of each road-section the Resident Engineer shall amend and perfect his original cross-section book by drawing thereon, in permanent red, the actual formation as completed, showing the parting lines between various classes of material, and the actual quantities of said various classes as contained in the final estimate of the graduation of said road-section; together with a statement of the cost of said graduation to the Contractors and to the Company, which amendments the Division Engineer shall thereupon cause to be incorporated in his own copies of the cross-sections, after revision by him, and shall, when requested, or on the completion of the work, transmit the originals to the Associate Engineer, endorsed with his approval.

3. The statement of cost to the Contractor should comprise, as nearly as can be ascertained, the value per item, and the amount of labor, material, use of tools and machinery, superintendence, and sundries, distributed and assigned in such detail as information on hand shall warrant. The statement of cost to the Company should be a summary of the final estimate.

4. The cross-section books will be paged with consecutive numbers; no erasures shall be made in them, nor shall any leaf be removed therefrom from any cause whatsoever. If errors occur cancel the page in such manner as not to obscure the errors, and use the next page.

5. Resident Engineers shall also prepare a series of masonry drawings, on white paper sheets of uniform size furnished for the purpose, in which all such structures, including drain-pipes shall be represented on a scale of 4 feet to the inch, or 8 feet to the inch, as the Division Engineer may prescribe for structures of various magnitude. Such drawings shall show the said structures in plan, elevation, and section as actually built, inclusive of foundations, foundation pits, substructure if any, grade line, and elevations of leading details. There shall be also a legend on the drawing of each separate structure, stating clearly the actual quantities of the various classes of work included in the final estimate, and a summary, such as is prescribed for graduation, of the actual cost to the Contractors and to the Company.

6. On the completion of each subdivision said cross-section, tunnel, and masonry drawings shall be transmitted to the Division Engineer, and by him, when so requested, after correction therefrom of the copies on his files, transmitted, with his approval affixed, to the Associate Engineer.

7. Each drawing of the two sets described above shall be exactly localized, in its title, with the name of the division, sub-division, section, station and plus.

8. Each Division Engineer, at or before the time of transmitting his first monthly estimate, shall send to the Associate Engineer a complete profile, on mounted "Plate A." paper, of his Division, showing alignment, gradients, and other full details as finally established for construction.

9. Then, and thereafter with each monthly estimate, he shall forward to the Associate Engineer tracing exhibits, or written memoranda, indicating the condition of the work at the date of said estimate, from his progress profile, in order that the progress profile in the Central Office may be supplemented to match.

10. All progress profiles shall represent the work done during each month in transparent washes of color, as follows:

January,....*Carmine.*	July,.....*Scarlet.*
February ..*Green.*	August,.....*Dark Green.*
March,.... *Yellow.*	September ,.....*Orange.*
April,.....*Cobalt Blue.*	October,.....*Purple.*
May,.....*Burnt Sienna.*	November,.....*Burnt Umber.*
June,.....*Black.*	December,..... *Gray.*

11. Each Division Engineer shall cause to be prepared, on mounted white roll paper, a complete map and profile of his division, horizontal scale 400 feet, vertical scale 40 feet to an inch, both on the same sheet, showing the center line, grade line, and land lines of the road in red, streams in blue, brick and frame buildings in carmine and burnt sienna respectively, faintly colored; all other details in India ink, with 10 feet contours finely drawn, each even hundred slightly heavied, and the outer limits of road formation—that is to say, the crests of cuts and the toes of fills—indicated in plan by dotted lines. This document to lie on the stocks in the Division Office, gradually perfecting, and finally including all the company's lands and buildings, together with such supplemental plans, to larger scales, as the Chief Engineer shall order, of town properties or particular reaches of the road, whereupon it shall be filed in the Central Office as a permanent record. The above map should embrace, if possible, all the topography obtained during the surveys within one mile on each side of the located line, and should be neatly and accurately executed.

12. Each Division Engineer, contemporaneously with the foregoing map and profile, shall cause to be prepared a complete record and description, by sections, of the finished roadway on his division, after the following general form, to be furnished from the Central Office:

S. P. R. R., Div. No. . . . .Sec. No. . . .

Sta.	Dis.	Def.	Alignment.	Mag. Course.	Right of Way. L.	Right of Way. R.	El'va. Ground.	El'va. Grade.	Gradient.	Width of roadway.	Cross Sections. L	Cross Sections. C	Cross Sections. R	Graduation. C. Y. Rock.	Loose R.	Earth.	Embk.	Found.	Misc.

Masonry Classes, C. Yds. 1.	2.	3.	4.	Misc.	Description of Masonry structures	Description of Bridges and viaducts.	Misc.	Rema'ks

13. To the record of each road section shall be appended a summary of the final estimate for said section, as paid by the company, and the column of remarks shall contain the miscellaneous notes from office records previously compiled, together with such other information, as to boundary monuments or plusses, bench marks, foundations and sundries, as may be of use on future enlargements of the road bed and Right-of-way.

14. Division Engineers shall require periodically from their subordinates the data necessary for the compilation of this record. On its completion they will entitle it, adding a brief description of the Division, its locality and terminal points, and transmit the record to the Associate Engineer, endorsed with their approval, for the Company's archives.

15. Resident Engineers shall keep a series of field books, to be called "Construction Notes," one of which shall be always borne about them, and used for recording their daily doings, noted on the spot, with day, date, and locality specified. In these books all field operations relating to the work of the Contractors shall be calculated and entered, such as the giving of line or grade, setting or resetting cross-section stakes, laying out tunnels and structures, measurements for estimate, dimensions and depths of foundation pits, coffer-dams, elevations of bridge seats, verbal orders given to the Contractors or their agents; in short, all their transactions and observations on the line, together with a diary of office work. The current volume of this series should be delivered to the Rodman for his use, if charged with separate field duties, in case of the absence or disability of the Resident. These books shall be numbered consecutively and plainly marked, on the outside, with the names of the Division and Subdivision, and the periods of time covered by them. They shall be preserved with great care, and turned in to the Division Engineer on the completion of the respective Subdivisions, or when called for.

16. Resident Engineers shall use and preserve bound books, to be furnished from the Central Office, instead of the common scratch-blocks, for office calculations, draughts of estimates, all figuring of exhibits or returns called for by the Division Engineer, and statements requested by others entitled to them, with day and date noted at the time of each entry. These books shall be called "Blotters," and shall be numbered and marked as prescribed for "Construction Notes."

17. Division Engineers shall keep similar books for the record of their daily doings in the office or field, and these, together with those of the Resident Engineers, shall be delivered by them to the Associate Engineer, on the completion of the work, or when called for. "Construction Notes" and "Blotters" shall be left in the original manuscript, and not inked over if in pencil. If errors occur, cancel in such manner as to leave them legible, and insert the corrected work further on, noting the former as erroneous, and referring to the latter.

18. Division, Principal Assistant, and Resident Engineers, shall preserve press copies of all official written communications sent out by them, in bound volumes, to be properly titled and indexed, and handed in to the Central Office on completion of the work. They shall endorse and preserve all like communications received, to the same end.

19. Principal Assistant and Division Engineers will be supplied with copies of the contracts and specifications relating to their charges. They may be commissioned by authority of the Chief Engineer to negotiate contracts for labor, material, or right of way in special cases, but all such contracts must be conditioned on the approval of the Chief Engineer, signed by himself or other immediate representative of the Company, and the originals filed in the Central Office.

20. All subordinates of this Department responsible for the right conduct of work, shall hold the Contractors to its timely and proper execution, in accordance with the terms of the agreement and the requirements of the specification. They should not only be vigilant to prevent any hindrance to the Contractors, but active and prompt to keep well in advance of them, so that there shall be no just cause of complaint for lack of stakes or instructions. All official communications to the Contractors should be clear and explicit, and respectful in tone, and should be recorded at the time, as herein elsewhere directed. Orders and instructions shall be given in writing, when asked for by any Contractor, Sub-contractor, or Foreman.

21. Should it appear, in any case, that the conditions of a contract are likely to fail of fulfillment, as to time of completion or otherwise, the Associate Engineer shall be seasonably informed of it, with a statement of the causes. Any radical remedies provided for in the contract must be administered by the Chief Engineer only, or by express authority from him.

22. All maps, drawings, papers and books should be clearly marked with titles, numbers and character, and orderly bestowed and catalogued for ready reference in the offices of this Department. Division Engineer should see that their subordinates conform to this rule, and they should, at frequent intervals, inspect the instruments furnished their Subdivisions, to make sure that they are kept in adjustment and not ill-used.

23. No original records shall be permitted to leave the respective offices, excepting as herein prescribed. Other Departments or Agencies of the Company entitled to information from this Department must be served by copy only, and not by the original drawings, sections, or records unless the Chief Engineer expressely warrants a deviation from the rule.

24. All regulations herein contained for the government of Line Engineers proper shall govern Principal Assistants, and others in the special service of the Department, to whom they are clearly applicable.

(TO BE CONTINUED).

Green Mountain Railroad.

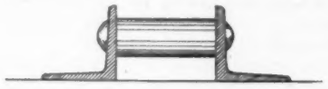
Written for ENGINEERING NEWS.

BY E. E. RUSSELL TRATMAN.

It is very generally supposed that the only railroad on the rack system in this country is the Mount Washington Railroad, in New Hampshire This had always been the opinion of the writer until last summer, when, in looking over some guide books while deciding where to spend his vacation, he happened on a brief notice of a rack railroad at Mount Desert, Maine, which finally decided his route, and as he gathered considerable information with regard to the road he has thought that the same might be of interest to readers of ENGINEERING NEWS.

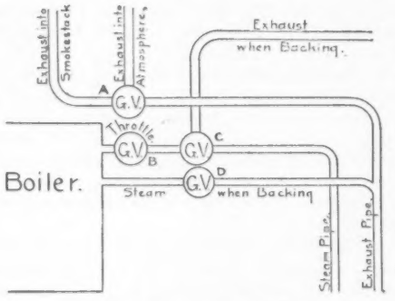
The road is situated on the island of Mount Desert, Me., about five miles from the town of Bar Harbor, and is built, as its name implies, up the side of Green mountain, which is the highest peak on the Atlantic coast, the summit being 1,527 feet above the level of the sea.

The location was made in December, 1882, and January, 1883, by Mr. A. F. Hilton, formerly chief engineer of the European &



Section of Rack.

North American R. R. and now chief engineer of the International R. R.; the mountain was at the time covered with snow and ice. Mr. Hilton, however, was appointed to the Megantic survey, and he was succeeded by Mr. Warren Nickerson, of Orrington, Me., now chief engineer of the Monson R. R.; under whose supervision the road was constructed. Work was commenced March 18th, 1883, and in order to have the road in operation for that season men and materials had to be obtained regardless



Arrangement of Piping.

of expense; the snow had to be removed over the entire length of the line and much other work was required that could have been avoided under other circumstances. The work of construction was done by day labor, under the direction of Mr. Nickerson. Oxen were used to haul the timber except where the grades were too steep for them to be used.

The road has a length of 6,300 feet from Eagle lake to the summit, with a rise of 1,254.5 feet; the profile is a succession of steep grades alternating with short lengths of easier grades. The maximum grade is 1 in 3, the minimum grade 1 in 20, and there is one curve with a radius of 1,910 feet. Mr. Hilton stated that curves of from 1° to 4° were practicable but the designer of the engines thinks (as stated in a letter to the writer) that this is rather sharper than the engines can well work, as too sharp a curve makes the gear wheel stand at too great an angle on the rack. The gauge is the standard 4 feet 8½ inches; the Mount Washington R. R. has a gauge of 4 feet 7½ inches, as the originators thought the wheel flanges should run closer than on ordinary roads; but by the advice of the general manager of the older line the Green Mountain R. R. was built to standard gauge.

For the greater part of its length the road is built on the solid ledge, there is no trestling, but wherever filling was necessary the substructure was built up solid with logs framed together. After clearing and leveling the surface of the ledge, holes were drilled in the rock at intervals of six feet, and 1¼-inch iron bolts were driven through the timbers and into these holes, thus securing an immovable purchase for the driving gear. Where the stringers are above the surface of the rock they rest on bed ties, to which they are fastened by 1¼-inch bolts; these bed ties are spaced at 6 feet intervals and bear against two or three 1¼-inch bolts driven into the ledge on the down-grade side of the tie. The timber work was done with great care, first-class ship carpenters being specially employed thereon. The track ties are 6 feet long by 6 inches by 6 inches, they rest on the stringers and are fastened by ¾-inch iron bolts driven in a groove on the down-grade side of the tie and into the stringer, thus preventing lateral as well as lognitudinal movement. The track is laid with T-rails weighing about 40 pounds per yard, spiked to each tie with two ordinary spikes. The rack is of the old "ladder" type, laid midway between the rails; it is built up of angle irons, 3 inches by 3 inches, placed 4 inches apart, with 1½-inch round bars shouldered and riveted between them; the pitch is 4 inches. The rack was made in sections 12 feet long and is fastened by 5½-inch lag screws, fourteen to each section. It was made at the Atlantic Iron Works, Boston, Mass., and cost $1.25 per foot. On the right hand side of the rack the ties are notched to make way for the spur wheel on the cog-wheel shaft of the engine.

The locomotives are similar to those on the Mount Washington R. R. The engine and small tank are on one frame and are carried by four wheels, these wheels not being driven by the engine but only 'carrying' wheels; the boiler is inclined at a considerable angle to the horizontal in order to maintain a sufficient depth of water over the firebox on the steep grades. They weigh twelve tons and are geared to work to 550 H. P. They consume about ¾ of a cord of wood per trip. There are four cylinders, 8 by 16 inches, operated by one throttle; each pair is placed end to end midway of the frame, the connecting rods driving two pinion shafts, one under the smoke-box and one under the tank; the pinions gear with spur wheels on the cog-wheel shaft. As on the steep grades the exhaust would be too fierce to be used as a steam blast, it is divided by a valve in the exhaust pipe so that the exhaust steam can be sent through the smoke stack or discharged direct into the atmosphere, thus forming the best known means of regulating the fire. In coming down the train runs by gravity, the motion being kept in forward gear, forming a powerful air-brake; to prevent the cylinders heating when working in this manner they are lubricated by a small jet of water let into the supply steam pipe to cylinders (about as much as would run through a $\frac{1}{16}$-inch hole for each pair of cylinders), this is got rid of by keeping the cylinder pet cocks open. To hold the train it is only necessary to stop the pistons; this is done as follows: steam is shut off from the pipe leading to the cylinders, air is taken in from the exhaust pipe and by a branch pipe from the steam pipe is let out into the atmosphere by means of a valve in this pipe, which valve regulates the speed by the amount of air that is let through it; one quarter turn on a 2-inch ordinary globe valve will generally give the train about the right speed. The amount of air forced through the four cylinders, therefore, goes through a very small space. This brake is very effective and is an elastic one. These engines will back with only one eccentric and without any link motion, which no other engines will do; they are only reversed to back off from the top of the hill and to run into the engine house at the base. This is effected in the following manner: steam is shut off from the boiler to the cylinders by a globe valve, between which and the cylinders a is branch pipe leading outside, also closed by the globe valve; there is also a valve in the ex-

haust pipe, and a pipe from the boiler leading into the exhaust pipe between this valve and the cylinders, this pipe also having a a globe valve; the steam chest cover is fitted close down on top of the slide valve to prevent it from lifting when backing. The main valve in the exhaust pipe (A) being closed, as well as the valve on the steam pipe (B) that supplies steam while working forward, the valve in the steam pipe that opens to the atmosphere (C) is opened; then the valve in the steam pipe leading into the exhaust pipe (D) is opened; by this means steam is let into the cylinders through the exhaust pipe and is exhausted through the steam pipe, being thrown direct into the atmosphere. The steam being let in under the slide valve it is necessary to have the steam chest cover fit close down to prevent the valve from lifting.

Mr. Walter Aiken, general manager of the Mount Washington R. R., stated the following in a letter to the writer: "I tried an experiment a few years ago that somewhat surprised me. It was to ascertain the power required to push a load up hill and the power required to hold the same load coming down. I loaded a freight car and shoved it on a uniform grade of 1 in 3 and let the steam go down while running. The train stopped when the gauge showed 80 pounds. I then blew steam off from the boiler and let the train down hill, exhausting the air into the boiler instead of into the atmosphere outside, and the train stopped when the gauge showed 37½ pounds. The engines are nicely constructed, and I was very loth to allow all this amount for friction."

On each pinion shaft is a ratchet wheel, with a pawl hinged to the engine frame; this is to prevent the gear from turning backwards in case of accident; the pawl is supposed to be in constant use, but when the writer traveled over the road it was lifted clear of the ratchet, a rod leading to the cab enabling the engineer to put it in operation on emergency.

The engines are built from the same drawings as those for the Mount Washington R. R.; the first engine used was taken from the older line and it only needed to have the carrying wheels set out ¼-inch on each side to fit the difference in gauge; this was easily done by putting washers inside the hubs of the wheels, as they all run loose on the axles.

The engines weigh about 12 tons; they were built at the Manchester Locomotive Works, Manchester, N. H., and cost $5,000.

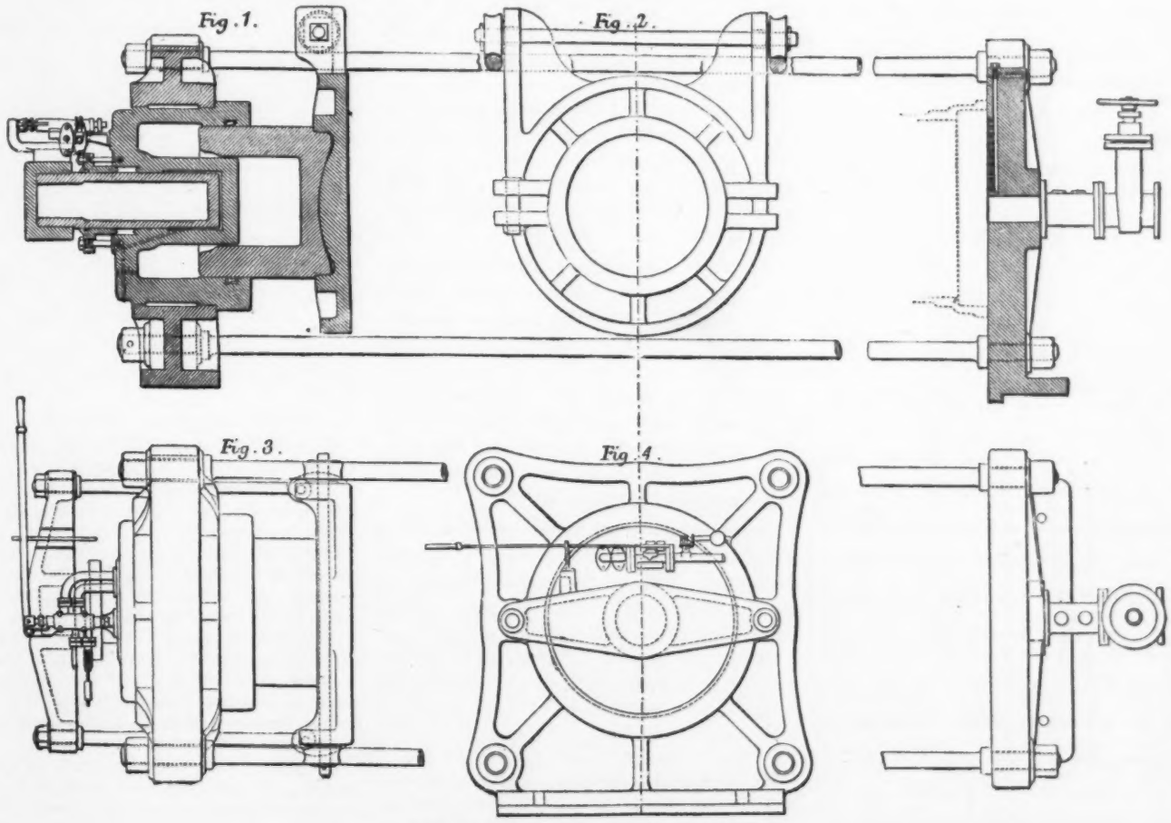
The cars are open-sided, with transverse seats, low floor and wide foot-board, the seats are inclined so as to be comfortable on the grades. Each car is provided with hand brakes and with the ratchet and pawl arrangement, they were built by the Hinckley & Egery Iron Co., of Bangor, Me. There are two locomotives, two cars, and a small truck for baggage and freight. The car is not coupled to the engine. Only one car is run at a time with one engine; the load varies from a few passengers to 80 or 100. The speed of the train is about three miles per hour, the piston speed being about 16 miles per hour.

The cost, to date, is stated to be $100,000; and much expense could have been avoided had time been taken for the work; the principal items of expense for such a road over one of ordinary construction, are the bolting of the ties to the rock or the track stringers, and the rack.

From Bar Harbor the company runs a line of stages and buckboards to Eagle lake, a beautiful sheet of water among the mountains, across which a quaint little stern-wheel steamer runs to and from the railroad wharf. A line of railroad is projected to the town. The traffic varies from a few to 150 passengers per day; the bulk is made up of visitors and tourists, with those admirers of high altitudes who spend the season at the Summit house. Extra trains are chartered for picnic and excursion parties. Observatories, etc., are proposed to be erected at the summit. The railroad company is a successful concern.

From a picturesque point of view it would be hard to find a more delightful trip than the round trip from Bar Harbor to the summit of Green mountain and return. The view on clear days is magnificent, and to those who, like the writer, make a first trip on a line of such a grade there is a novel excitement in the slow ride up the ladder-like railroad.

In conclusion the writer would acknowledge his obligations to the officers of the company for the courtesy shown during his visit, and also to the engineers and officers of the company and to Mr. Aiken, of the Mount Washington R. R., for much interesting information respecting the railroad and locomotives.



Kennedy's Hydraulic Pipe-Testing Machine.

Pipe-Testing Machine.

We illustrate this week Kennedy's pipe-testing machine constructed by the Glenfield Company, Limited, of Kilmarnock. In this machine the pipe to be tested is held between two heads which are forced towards each other by hydraulic pressure, the joints at ends being made by wrought-iron rings wrapped with fine gaskin and dipped in tallow. One head is movable, and is attached to a hydraulic ram to which pressure is admitted from an accumulator. This head is drawn back to release the pipe under test by a smaller ram (Fig. 1) the cross-head of which is connected by two rods (Fig. 3) with the head. The pressure of the water admitted to the interior of the pipe is regulated by an adjustable safety valve, and when this is once set to give the required pressure, the operation can be entrusted to a boy.—*The Engineer.*

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AND

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ECKMEYER & CO., CEMENT, New York.
JORDAN, F. RAILROAD SUPPLIES, New York.

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WE take pleasure in announcing to our readers that Mr. A. M. Wellington, late technical editor of *The Railroad Gazette*, will hereafter be identified with ENGINEERING NEWS, both as a member of the editorial staff and as a component part of the ENGINEERING NEWS PUBLISHING COMPANY.

Mr. Wellington needs no introduction to our readers; his ability and experience as an engineer, as the technical editor of a most successful journal and as a writer of acknowledged merit on the advanced theory and practice of railway engineering, have already made his name well and favorably known.

ENGINEERING NEWS has prospered, for which it gratefully returns thanks to its patrons; but this prosperity has also made necessary a division of labor and a reorganization of, and addition to, its editorial and working staff; and it congratulates its readers upon the circumstances which have made possible the present combination.

The policy of the paper remains unchanged; but it is expected that its field of usefulness will be greatly extended. As to the exact shape the planned improvements will take, we prefer to illustrate by deeds rather than by promises.

Mr. Frost, the original founder and long-time sole proprietor and editor of ENGINEERING NEWS, now finds that the business management of the paper has assumed proportions that make it imperatively necessary that he devote his undivided attention and the experience gained in past and more trying years to this department. Mr. Stauffer and Mr. Wellington will head the editorial staff, to which other additions are being made.

The revision of proof on his new work on the "Economic Location of Railways," now passing through the press, will make it impossible for Mr. Wellington to immediately assume his editorial position. But in a very few weeks he expects to be at work in earnest, and the results of the reorganization will, we trust, soon be apparent to our readers.

WE expected to give with this issue a portrait and biographical sketch of MR. WM. E. WORTHEN, President of the American Society of Civil Engineers for the current year. But an accident to the finished plate, while still in the hands of the photo-electrotyper, will delay its appearance until our next issue.

The Engineer, in commenting on the late accident on the Baltimore & Ohio R. R., never mentions stove once, but charges all the loss of life from fire to the "continued use of oil or other swing lamps" in our railway cars; and our contemporary gravely reproves us for not introducing gas-lighting as a "better, cheaper and safer light," and as successfully used in France and Germany and to some extent in England.

We think our English cousins might gain some interesting and valuable information on this subject from the practice of American trunk lines. We practically long ago discarded the "barbarous and antiquated" oil lamps, to which the majority of the English railway corporations still cling, and light with the approved gas, and by methods far superior to the practice of the continental lines recommended.

It is in the heating of our cars, and not in their lighting, that we still in great part, adhere to most reprehensible methods. There *is* something "barbarous" in placing two blazing furnaces inside of our cars in a manner that will insure slow torture by fire to imprisoned passengers in case of an accident. The trouble, and the shame in this matter of heating is that our railway companies know better, and other and safer methods are in successful use on certain lines; but the majority adhere to the cheaper plan, and will continue to do so until a stronger hand than theirs enforces the adoption of some plan which will prefer the public safety to corporation thrift.

Some Facts About Steam Heating.

Prof. Charles A. Smith, in his treatise on "Steam Using," records as the practice of the Dubuque Steam Supply Company, at Dubuque, Iowa, that with the external air ranging to 0° Fahr., 1 square foot of heating surface in radiators warms a number of cubic feet, as follows, in columns 2 and 3.

Character of Building.	When the Heaters are in Same Rooms.	When Heaters are in Basements, and Warm air.
	Cub. Ft. per Sq. Foot.	Cub. Ft. per Sq. Foot.
Dwellings	50	40
Stores, Wholesale	125	100
" Retail	100	80
Banks, Offices, Drug Stores	70	60
Dry Goods	80	70
Hotels, Large	125	100
Churches	200	150

Column 2 represents the direct system, and Column 3 the indirect system of steam heating, and the juxtaposition of the two columns well serves to call out the relative efficiency of the two methods.

It will be noted that the indirect system demands more radiating surface, and is consequently the more costly in initial outlay, as it is the more expensive in fuel, but it implies advantages of ventilation and supply of fresh, pure air to the rooms, which render it more healthful, and secure its establishment in hospitals, dwellings and other institutions where stress is laid on having the best sanitary conditions.

It regard to the boiler surface required to supply the radiators with sufficient steam, one horse-power of boiler, or say 15 square feet of boiler heating surface, will be found adequate to supply about 100 square feet of radiating surface, or 1 square foot of boiler heating surface will supply about 7 square feet of radiating surface.

The above proportions will certainly secure ample heating, though at times a smaller boiler capacity, especially in large plants, will answer. But it is better to be on the safe side, the only extra expense being the initial outlay, than to have too small a boiler capacity, and thus affect the efficient workings of the business, mill or factory, by cold, more especially in the most severe weather.

What we have said as to the duplication and dividing up of the boiler capacity, in our issue of September 25, 1886, in relation to pumping engine plants, applies also to steam heating plants of large capacity, though not with quite the same force, since the intermission of work on Sundays enables, if desirable, the proper cleansing and repairs of boiler on one day each week.

For the sizes of pipes for steam mains and

returns, the following rule will be found to give satisfactory proportions.

The cross-sectional area of pipe, in square inches, should be a constant of .30 of a square inch, plus for each 100 square feet of heating surface in radiators, .36 of a square inch, when exhaust steam is used; .18 of a square inch when live steam is used, and .09 of a square inch for the condensed water (viz., the return).

Dividing the respective cross-sectional areas thus obtained by .7854, or say multiplying them by $\frac{4}{3}$, and then taking the respective square roots, the proper diameters, in inches, will be obtained.

When the overhead system of steam heating is employed, in which system direct radiating pipes, usually 1¼ inches in diameter, are placed in rows overhead, suspended upon horizontal racks, the pipes running horizontally, and side by side, around the whole interior of the building, and being from 2 to 3 feet from the walls, and from 2 to 4 feet from the ceiling, the amount of 1¼-inch pipe required, according to Mr. C. J. H. Woodbury, for heating mills, for which use this system is deservedly much in vogue, is about 1 foot in length for every 90 cubic feet of space. Of course, as Mr. Woodbury points out, a great range of difference exists, due to the special character of the operating machinery in the mill, "both in respect to the amount of air circulated by the machinery, and also the aid to warming the room by the friction of the journals."

In a later issue we hope to be able to present some further facts relating to the important topic of Steam Heating.

Locomotives in Brazil.

The *Coal and Iron Trades Review* reproduce a report by Mr. Haggard, H. B. M. Secretary of Legation at Rio de Janeiro on the decline of British trade as compared with German and Belgian in Brazil, which after explaining the action of the steamer line from Antwerp in gathering Belgian and German cargoes, and the conservatism of the British merchant adds an item of interest to Americans, viz.:

"A circumstance has come to my knowledge which is perhaps more alarming, as affecting the future interests of English trade here, than anything of which I have previously heard. Hitherto the German has only contended with us in articles of clothing, stuffs, etc.; now he threatens, he has begun to invade us, not unsuccessfully, on ground where we, too confident, thought ourselves unassailable. The agent of a German company contracted for the supply of Bessemer steel rails to the 'Itapemirim Railroad.' The same firm wished to tender for the locomotives required. The railroad company wished to have Baldwin's (American) engines. These locomotives cost about £1,800 each. The German agent offered to supply as good a locomotive for £1,150 each, but the railway company would have nothing but Baldwin's engines. The German agent then offered to let his engine run for twelve months without payment, and agreed to take it back if it did not prove satisfactory.

"It is a most significant fact that during this contest there is no mention of any English firm making any tender, and whilst this instance proves the energy of the German agents, and how hard they are working to get a footing for their machinery in Brazil, it also proves the want of energy of the British contractor and manufacturer.

The Secretary does not think the changes in trade recited are due to special protection by German or Belgian officials or lack of it on the part of English officials, but that they "are simply a natural effect of a natural cause."

CHARLES G. DARRACH, M. Am. Soc. C. E. and late Principal Assistant Engineer of the Philadelphia Water Department, has been admitted to partnership in the well known engineering firm of Wilson Brothers & Co., of Philadelphia.]

Earnings of English Tramways.

In our last issue we gave a short exhibit, from *The Railway News*, of the mileage of English tramways; we now from the same source show the revenue and net receipts.

For the year ending June 30, 1886, the 133 English and Welsh companies, the twelve in Scotland and fourteen in Ireland, earned a gross revenue on their 865 miles of line equal to $13,151,655, or $16,205 per mile; for the previous year the return was $16,110 per mile. In the twelve months, 1885-86, there was an increase of $49,650 in passenger receipts, $27,800 in parcels and mails and $8,995 in animals and goods traffic. Against the revenue increase, however, must be set an addition of $229,885 in working expenses, due mainly to severe weather and increased pay to men; these working expenses in gross amounted to 77 per cent. of total receipts as against 76 per cent. of same for 1884-85.

The heaviest mileage receipt is $68,705 earned by the London Tramways Company, of which 22 per cent, was next profit. The results between the use of mechanical and horse-power vary widely; on the Birmingham and Western lines, with horse-power, the cost of working was only 53 per cent. (the lowest in England); but on the Barrow-in-Furness the percentage was 90, and on the Birmingham Central, 76, both by horse. Of those worked by locomotives, the working cost on the Burnley and District was 67 per cent.; North London, 82; the North Staffordshire, 62, and on the Gateshead and District, with some very heavy gradients, 93 per cent.

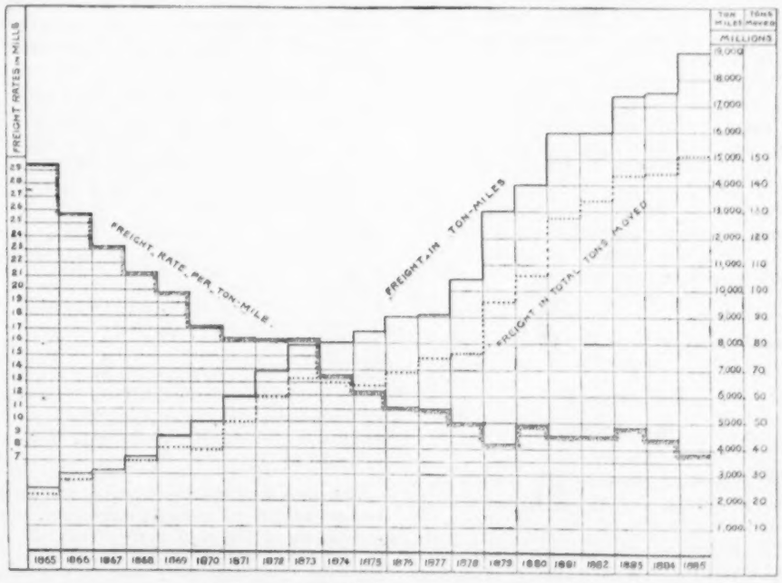
FREIGHT RATES in MILLS
FREIGHT RATE PER TON-MILE
FREIGHT IN TON-MILES
FREIGHT IN TOTAL TONS MOVED
TONS MOVED
MILLIONS
1865 1866 1867 1868 1869 1870 1871 1872 1873 1874 1875 1876 1877 1878 1879 1880 1881 1882 1883 1884 1885

Diagram of Freight Rates. Tonnage and Mileage.

The Inter-State Commerce Bill.

In the last number of ENGINEERING NEWS, under the above title, reference was made to Mr. Poor's statement to the British investors, showing the course of railroad freights and charges on twenty-one leading roads of this country, from 1865 to '85.

A diagram showing the total tons moved, ton mileage and rate per ton mile is presented herewith, also the table from which it is constructed.

It may be safely doubted if any country or any trade, of magnitude, can show a like or approximating increase of service or decrease of cost.

If the ton mileage above reported for 1885 had paid the rates which J. S. Jeans, in his report to the British Iron Trade Association for 1884, asserts are paid in England, viz.:—2 cents per ton-mile we would have paid for freight, on these twenty-one roads, over 252 million dollars more than we did. And the saving for the seventeen years that those rates have been below the British rates, amounts, on the roads mentioned, in round numbers, to 1,743 million dollars.

Yet there are persons, who, for reasons not immediately apparent, assert that the railroad rates of this country are exorbitant!

There is a general impression that "rate wars" are of advantage to terminal points only, that the local shipper is oppressed and hindered of facilities at such times. The average length of haul as taken from the above table and compared with the rate charged, does not show this. There has been, on these main lines, an increase in the length of haul from about 105 to 122 miles.

In 1879 a drop in the rate of a little over 13 per cent. decreased the average haul three miles; in 1880, an increase of less than 13 per cent. in the rates increased the length of haul by 6 miles, to 141 miles, the maximum length of haul for the years mentioned: while the length of haul subsequently decreased under a further fall also on a slight rise; and for 1885, is 124 miles, longer than in any year since 1880.

No convincing conclusions can be drawn

Year	Tons.	Ton-Miles.	Freight Earnings. Dollars.	Rate per Ton per Mile. Cents.
1865	23,370,245	2,370,763,370	69,826,918	2·945
1866	28,490,854	2,981,762,929	77,063,840	2·582
1867	30,840,120	3,222,823,618	75,381,167	2·338
1868	35,170,511	3,743,468. 59	80,141,586	2·140
1869	39,834,854	4,408,321,158	87,426 269	1·983
1870	39,245,126	5,111,393 311	88,488,749	1·731
1871	50,256,362	5,937,679,439	97,186,537	1·636
1872	59,211,470	6,972,091,474	112,408,445	1·612
1873	67,384,083	7,885,701,871	127,045,529	1·611
1874	65,416,243	8,020,101,851	108,598,701	1·754
1875	63,921,132	8,380,101,851	107,657,842	1·284
1876	69,068,758	9,072,838,869	102,009,936	1·124
1877	73,556,320	9 131,613,379	100,894,137	1·103
1878	75,557,679	10,433,738,419	105,973,664	1·015
1879	96,335,7?5	13,033,722,960	114,255,142	0·876
1880	106,485.055	14,985,993,417	139,331,274	0·968
1881	126,750,15:	16,074,694,336	146,699,556	0·912
1882	134,123,596	16,075,166,683	147,719,107	0·918
1883	142,655,117	17,307,648,667	167,464,195	0·968
1884	144,291 331	17,501,750,521	153 735,627	0·878
1885	150,972,025	18,837,729,706	144,562,048	0·767

from the data presented by the table, but as the average haul was shortened in 1879, a year of intense and long continued rate war, the Chicago—New York *published* rate for grain falling to ten cents, or two mills per ton mile, and the average haul was lengthened in 1880, a year of peace and higher rates, it may be doubted if the interests of intermediate points suffer as much as has been assumed. It is noticeable that neither the tons moved nor the ton-mileage have lost the impetus given to them by that year, of what may be considered abnormally low freights.

Much stress is laid from time to time on the advantage this country derives from low freight rates in exporting grain. While our large exportations undoubtedly add largely to our favorable balance of trade, their great volume in the European market reduces the price, and the total tonnage of grain, meal and breadstuffs of all kinds, exported both from the Atlantic, Gulf and Pacific coasts, in the year ending June 30, 1885, was less than 5½ million tons.

The value of through freights as well as our export trade is presented with too much emphasis. Of the twenty-one roads whose traffic statistics were compiled by Mr. Poor, five, viz: The Boston & Albany, Michigan Central, New York Central, Pennsylvania, and Pittsburg & Ft. Wayne, distinguish in Poor's Manual, between way and through freights. These five roads return 63,656,919 tons of freight moved, of this a fraction over 85 per cent. is local, leaving less than 15 per cent. for through freight. Yet a little over half of the through freight on these five roads equals our total exports of breadstuffs.

PERSONAL.

A. G. KLEINBECK has been appointed Superintendent of the St. Louis & Chicago R. R., with headquarters at Litchfield, Ill.

W. H. CLEMENT, who had been connected with the Little Miami R. R. and the Cincinnati Southern R. R., and who was interested in the building of the St. Louis bridge, died at Cincinnati, O., January 17.

CAPT. JOHN A. GRANT, the recently appointed General Manager of the Texas & Pacific R. R., has recently made an inspection tour over the road; accompanied by L. L. KELLER and W. J. CARNATHAN, the Superintendent and Roadmaster respectively, of the Rio Grande Division.

JOHN F. WALLACE, M. Am. Soc. C. E., Asst. Engineer U. P. Ry. has resigned, to accept the office of Assistant to O. Chanute, Chief Engineer of the New Atchison, Topeka and Santa Fé bridges near the Missouri river at Sibley, Mo., and over the Mississippi River at Fort Madison Miss.

R. E. PEARY, Civil Engineer, U. S. N., has been ordered to duty with the Bureau of Yards and Docks, Navy Department, Washington. MR. PEARY has just returned from a trip to Greenland where he went to examine the "inland ice" of that country. In a journey lasting twenty days he and a Danish companion, dragging their provisions on light sledges and traveling much of the time on snowshoes, advanced 100 miles into the icy desert and return, reaching an elevation of 7,500 feet above the sea level. This is the greatest elevation yet attained, and with one exception the longest distance traversed in the interior of Greenland. MR. PEARY also examined some 40 miles of the shore line of the great ice desert.

MOVEMENTS OF U. S. ENGINEER OFFICERS.—Lieut. Wm. M. Black goes to Key West, Jacksonville, Fort Marion and St. Augustine, Fla.; Maj. Jared A. Smith, to Portland and Fort Popham, Me.; Capt. R. H. Roxie, to Montgomery, Ala., and Pensacola, Fla.; Capt. F. A. Mahan, to Erie harbor, Pa.; Maj. Alex. M. Miller, to Chester, Ill., and Memphis, Tenn.; Lieut. Col. Wm. P. Craighill, to Richmond, Va.; Maj. James C. Post, to Lock 5, Kentucky river; Capt. Wm. T. Rossell, to Arkansas City, Leland Landing and Lakeport, Ark., and Wilson's Point, La., and Vicksburg, Miss., and Maj. T. H. Handbury, to Keokuk, Ia.

Annual Meeting of the American Society of Civil Engineers.

The Annual Meeting of this Society was held at its house in East Twenty-third street, on Wednesday, 19th inst. The total attendance was hardly as large as at some previous meetings, but the proportion of out of town members, including some of the most distinguished was notable. No especially animated discussions, or other features of interest outside of the usual routine occurred, and the Society adjourned at an early hour in the afternoon. In the evening quite an animated discussion took place on the subject of "Tests of Materials," as will be seen from our reports.

In the absence of the President, Mr. Charles E. Emery was chosen Chairman of the Meeting.

After appointing tellers to canvass the ballot for officers, the Annual Report of the Board of Direction was read by the Secretary, which was in substance as follows, omitting or condensing some of the less important parts:

REPORT OF THE BOARD OF DIRECTION.

As shown by the following tabular statements there has been an addition of 114, to all grades of membership, including one Associate and six Juniors transferred to Members, a net addition of 107.

The losses have been sixteen, nine by death, six by resignation, and one dropped, making the number now connected with the Society, 1019, a gain of 91.

The changes in each grade were:

Hon. Member.	Increase.	1	Total	9
Corresponding M.	"	—	"	3
Members	"	59	"	760
Associates	"	11	"	44
Juniors	"	17	"	106
				922
Fellows not included in other grades				57
Subscribers to b'd'g fund in other grades				40
Increase		91		1,019

The last Annual Convention at Denver was well attended and very successful.

Nineteen meetings of the Society were held in the year, one of which was the Annual Meeting, January, 20-21 1886, and the other the Annual Convention, July 2-7, 1886. Meetings have been held on the first and third Wednesday of each month, except July and August. Thirteen meetings of the Board of Direction were held during the year.

The publications of the Society have been considerably more extensive than in any previous year. By far the larger portion of the available income of the Society is devoted to its publications, and it is believed that this course is particularly desirable. There has been but one subscription to the building fund during the year. Two members have compounded dues by a single payment of $250, increasing the permanent fund of the Society by $500. Three Fellows have added $450 to the Fellowship Fund.

The Norman medal was awarded last year to Mr. Eliot C. Clarke, for his paper on "Tests of Cement," for the Boston Main Drainage Works, and the Rowland prize to Mr. A. M. Wellington, for his paper on "Experiments on Journal Friction at Low Velocities." Committees to award these prizes for the present year, will report at this meeting.

In accordance with the provision of a resolution adopted at the last Convention, a circular was sent to all members, and to various local Engineering Societies inviting written communications in respect to their views on any desirable changes in the organization of the Society, with a view to extending its membership and influence. Only six members had responded up to December 10th, and one Society (St. Louis.) The substance of these answers have been printed and distributed. Since that date, five other members and two Societies (Boston and Chicago) have responded. The substance of all the replies received is this:

The Engineers' Club of St. Louis, does not feel called upon to express any opinion as to any organic charge in the American Society, but favors a union of publications if on an impartial and satisfactory basis.

The Boston Society of Civil Engineers considers a joint publication of papers very desirable and believes a closer union of the American Society and the local societies would be for the benefit of the engineering profession; and that the Society would be glad to consider any proposition from the American Society, looking toward the accomplishment of these ends.

The Western Society of Civil Engineers is in favor of the organization of a national association of engineers, and is convinced that the details of such an organization can be most readily and satisfactorily matured by a conference of representatives of the societies in interest, and *Resolved*: That in furtherance of this purpose this society is ready at any time to send delegates to confer with those of the American Society of Civil Engineers and of such other society as may choose to participate at such time and place as the American Society may designate, and, *Resolved*, that the Secretary of this Society be instructed to send a copy of these resolutions to the Board of Direction of the American Society of Civil Engineers.

The substance of the replies from the eleven members was:

Five oppose at present any organic union with local societies.

Three favor permissive action for the formation of sections.

Three favor a modification of the present classification of members.

Six favor some form of joint publication.

One favors a national incorporation.

One favors special arrangements for unity in publications.

One favors local chapters of the Society, and where local organizations now exist, would make it possible for the whole body to become a chapter without conferring individual membership.

One favors a closer union with other national societies.

One favors a National Academy of Engineers.

Under the provisions of the resolution adopted at the last convention the Board reports as its conclusion that it is evident there is at present no desire for changes in the organization of the Society.

A number of applications for membership from foreign engineers of known high standing who have not the personal acquaintance of five members to endorse their application, being on hand, some modification of the Constitution to permit the Board to act specially in such cases is suggested.

The membership in detail on January 1st, was:

	Resident.		Non-resident.		Total.	
	1886	1887	1886	1887	1886	1887
Honorary member	2	3	6	6	8	9
Corresp'g member	—	—	3	3	3	3
Members	131	153	570	607	701	760
Associates	10	11	23	33	33	44
Juniors	23	25	66	81	89	106
Total	166	192	668	730	834	922
Fellows, excluding those also members					54	57
Subscribers to b'l. f'd.	"	"			40	40
Total connected with Society, January, 1st.					928	1019

Applications for admission pending January 1, 1886		21
Received during year	132	153
Pending on January 1, 1887		29
Elected on ballot		115
Elected as honorary member and fellows		4

Of the candidates elected, nine have not as yet qualified.

The library has been increased by 598 books and pamphlets, and 181 maps, drawings, photographs and engravings.

The members who have been lost by death during the past year have been: E. S. CHESBROUGH, *Past President*; C. SHALER SMITH, *Past Director*; MARTIN CORYELL, W. W. EVANS, E. A. FLINT, R. M. HOE, JAMES D. BURR, GEO. H ELLIOTT, and T. N. BAILEY.

The treasurer then submitted his report, which was in substance as follows:

Balance on hand, January 1, 1886	$1,945.78
Received from members	$17,703.91
Publications, interest, etc	3,264.93
Total Receipts	$20,968.85
Total Disbursements	$19,060.29

Committees then reported awarding the Norman medal to EDWARD BATES DORSEY, for his paper on "English and American Railroads Compared," and the Rowland prize to Mr. C. C. SCHNEIDER for his paper on "The Cantilever Bridge at Niagara Falls."

The Committee on Uniform Standard Time then submitted a very interesting report as to experience with the 24 o'clock system on the Canadian Pacific Railway where it has been in use for the past year west of Port Arthur on Lake Superior. A large number of letters were included in the report, which were absolutely unanimous in favor of the system, a striking feature being that it appears to meet as much acceptance among the general population as among railway people. As a result of their experience the system has been extended over a number of lines tributary to the Canadian Pacific but under independent management. The system is to be at once introduced over the entire Canadian Pacific system and it is expected to be in use from Halifax to the Pacific within a year. The universal satisfaction with the system, especially among the people along the line, was something which was hardly expected, and the Committee report that they "consider as settled the question of the ultimate adoption of the system. Sooner or later it is inevitable."

A resolution to send copies of the report to the various Time Conventions and to the leading railway officials of the country was then adopted, but resolutions submitted by the committee that the Society ask mayors of cities throughout the continent, and the Post Office Department to adopt the system for public clocks and reports were laid on the table as premature. As a substitute, a resolution favoring such action, but not to be sent out as a request from the Society, was adopted on motion of MR. COLLINGWOOD.

The death of Justus Dirks, Honorary Member, who was in this country with Count de Lesseps, as Consulting Engineer of the Panama canal, was then announced. Invitations were read and accepted from Col. Wm. H. Paine for any members desiring to visit the Tenth Avenue cable road, and from Mr. C. C. Martin, Chief Engineer and Superintendent of the East River bridge and Charles E. Emery, Chief Engineer of the New York Steam Heating Co., to visit their respective works.

The Committee on Compressive Strength of Cement submitted a report of progress. They have only recently succeeded in making the necessary arrangements for making desired tests. Prof. Swain (Mass. Inst. Technology) of the committee reported that tests had been made on a great variety of cements, set in air and water, of various mixtures of cement, and after various periods of time from one day to sixteen weeks. In no case was a change of dimensions of more than $\frac{1}{10}$ inch in 5 inches observed. Within these limits some specimens expanded, some contracted, and some did first one and then the other, as measured by very delicate apparatus.

The Committee on Joint Library were not prepared to submit any report. The Committee on the Form of Rails and Wheels, reported that they had held three meetings and were gathering statistics to more fully determine the facts in relation to the question, which consisted of two parts, the effect of the form of rails and wheels on the wear of wheels, especially in relation to sharp flanges, and their effect upon the wear of rails especially, in respect to flange cutting on curves or straight lines.

The time and place for the next convention was then discussed. Responses had been received suggesting a great variety of places but after remarks from Messrs. CROES in favor of Fortress Monroe, FORCE in favor of the Thousand Islands, and NORTH in favor of Saratoga it was resolved on motion of Mr. CORTHELL that the Board of Direction select the time and place which should be at some large hotel not in a large city. We apprehend the choice will lie between the three places named with the odds in favor of Fortress Monroe, which is in many respects a delightful point for a convention, with a large hotel of ample size to accommodate the entire party comfortably.

The tellers then reported, and the following officers were found to be elected, there being only a few scattered votes:

President: Mr. William E. Worthen.
Vice-Presidents: Mr. Thomas C. Keefer and Mr. Thomas F. Rowland.
Secretary and Librarian: Mr. John Bogart.
Treasurer: Mr. J. James R. Croes.
Directors: Mr. William G. Hamilton, Mr. Charles C. Schneider, Mr. Stevenson Towle, Mr. James Archbald and Mr. Robert Forsyth.

The usual excellent lunch was then served, and the afternoon session was very brief, MR. WORTHEN showed a specimen from a 27-inch, wrought-iron pipe laid in Lowell in 1845, in dry sand. It had been coated inside and out with coal-tar. It was entirely sound on the outside, but the inside was rather badly corroded. MR. FRANCIS stated that 8-inch cast-iron pipes laid in 1829, to sustain 150 feet head and now sustaining 200 feet, were still in use in good order although somewhat obstructed on the inside. These pipes had been laid before the days of coal tar.

Various of the older members then took part in an interesting discussion of the question of the durability of pipes or lack of it and the causes therefor. Zinc strips attached to iron pipes had had little effect. A cast-iron lining to a conduit on the Croton Aqueduct, protected on the inside by a thin coating of masonry had not oxydized at all in thirty or forty years. MR. GRAFF mentioned that two miles of old pipes laid in different soils in Philadelphia had been taken up some time since. Those laid in dry shore sand were not at all injured. Those laid in wet gravel were much corroded and fell to pieces when stored in an open lot during the winter. "Wet and dry" seemed to have acted on them as on wood. Those from clayey soil were about a medium of the two.

The Society then adjourned on motion of MR. FRANCIS till "20 or 30 o'clock" for the purpose of having a group photograph taken.

Members and Guests Present.

Wm. E. Worthen, Theo. Cooper, J. J. R. Croes, J. W. Adams, W. G. Hamilton, Gen. G. S. Greene, G. S. Greene, Jr., C. Macdonald, A. M. Wellington, G. S. Morison, New York; A. H. Emery, Stamford, Conn.; S. Towle, C. E. Emery, C. C. Martin, R. L. Harris, E. L. Corthell, New York; T. H. McKenzie, Southington, Conn.; C. G. Force, F. B. Aspinwall, New York; A. J. Zabriskie, Newark, N. J.; Chas. Kellogg, Athens, Pa.; E. W. Rathbone, J. F. Barnard, Geo. M. Bond, W. A. Nicholls, J. F. Rowland, E. B. Noyes, W. H. Wiley, John Bogart, New York; T. D. Lovett, Cincinnati, O.; J. W. Bacon, Hartford, Conn.; J. B. Francis, Lowell, Mass.; H. Bissell, Salem, Mass.; Cook Talcott, New York; H. C. Parsons, Albany, N. Y.; J. R. Freeman, D. McN. Stauffer, J. R. Thomas, E. B. Van Winkle, A. W. Trotter, S. S. Haight, A. Onderdonk, S. F. Shelbourne, W. J. Haskins, C. M. Harris, J. R. Wardlaw, J. S. Elliott, W. W. Maclay, T. Egleston, G. S. Simpson, F. Collingwood, G. A. Just, C. C. Schneider, F. A. Calkins, H. Loomis, W. R. Hutton, J. A. Briggs, J. F. Flagg, G. Leverich, E. P. North, C. W. Hunt, W. H. Paine, G. B. Mallory, G. E. Harding, J. C. Clarke, New York; G. H. Pegram, Wilmington, Del.; E. E. R. Tratman, Brooklyn; E. S. Safford, Arlington, Mass.; C. L. Rowland, Brooklyn, N. Y.; M. M. Tidd, Boston, Mass.; G. S. Fields, Buffalo, N. Y.; F. H. Baldwin, Dobbs Ferry, N. Y.; H. W. Parkhurst, New York; G. S. Simpson, Terre Haute Ind.; W. P. Judson, Oswego, N. Y.; J. A. Partridge, Washington, D.C.; J. Houston, Jersey City; P. K. Yates, Yonkers, N. Y.; Fred. Graff, Philadelphia, Pa.; S. H. Chittenden, Washington, D. C; A. B. Hill, New Haven; S. D. Richardson, New York; R. Fletcher, Hanover, N. Y.; S. S. Wheeler, New York; W. F. Booth, Poughkeepsie, N. Y.; J. F. Barnard, South Norwalk, Conn.; E. L. Safford, Arlington, Mass; Jos. Osgood, Toledo, O.; J. F. Sorzano, New York; C. M. Kelly, Dobbs Ferry, N. Y.; H. S. Goodwin, Bethlehem, Pa.; J. P. Putman, Boston, Mass; C. D. Ward, Jersey City, N. J.; J. S. Pegram, Wilmington, Del.; E. B. Guthrie, Buffalo; B. F. Richardson, Philadelphia; C. B. Brush, Hoboken; C. F. Purdy, Eau Claire, Wis.; Thos. W. Baldwin, Bangor, Me.; D. E. McComb, Washington; E. B. Weston, Providence; H. F. Rudloff, Venezuela; A. Beardsley, Swarthmore; Sam'l Rea, Philadelphia; A. F. Noyes, West Newton, Mass.; E. S. Gould, Scranton, Pa.; G. A. Kimball, Somerville, Mass.; J. R. Richards, Boston; H. Manley, Boston; S. M. Gray, Providence, R. I.; W. Stone, Providence, R. I.; C. A. Ferry, New Haven; F. C. Prindle, East Orange; M. J. Butler, Ontario, Canada; Wm. Rumble; J. G. Sanderson; A. Bryson; S. W. Hoag, Jr.; J. J. McLain; W. H. White; New York; G. C. Tingley, G. H. Bishop, Providence, R. I.; F. O. Whitney; C. A. Wilson; J. M. Knapp, New York; A. B. Paine, Poughkeepsie; M. A. Smith; B. D. Hasell; S. S. Wheeler; O. F. Nichols; C. E. Jackson; J. S. Elliott H. B. Seaman; O. W. Barnes; J. P. Davis; W. J. Booth, New York.

Engineers' Club of Philadelphia.

Record of ninth annual meeting, January 8, 1887. President Washington Jones in the chair; forty members present.

The Retiring President, Mr. Washington Jones, read the Annual Address. In it he gave a brief account of the most prominent engineering works projected, in progress and completed, abroad and in the United States; he attributed the fewness of them, and of industrial enterprises in our own country, to derangements caused by strikes and by the fears arising from efforts made to lessen the customs' duties on imports. The importance of railways to the people was dwelt upon; their bridges, tunnels, locomotives, etc., and the miles of track laid during 1886, were referred to. Street railways, and the manner of moving their cars, elevated railways and subway roads were compared and their qualities noted. New water-works, especially those projected for the city of Philadelphia were noted, and extracts from Mr. Rudolph Hering's report on his surveys of water sheds, forming sources of supply other than that of the Schuylkill river were quoted; also a description of the intercepting sewer (furnished by the courtesy of the Chief Engineer of the city of Philadelphia), intended to carry the sewage of Manayunk and discharge it below the pool at Fairmount. The quantities of minerals mined in the United States during several past years were noted and allusion was made to the Bartholdi Statue of Liberty. The concluding portion of the address was devoted to remarks upon the satisfactory condition of the club, the convenience of its quarters and location, and the desirability of an increased number of papers upon professional matters.

The Secretary and Treasurer presented his Annual Report for the fiscal year 1886. The following is a statement of the treasury accounts:

Balance, January 8, 1886	$ 609.40
Receipts	3534.82
	$4144.22
Expenditures	3779.03
Balance, January 7, 1887	$365.19
Others asset	1107.82
	$1473.01
Estimated liabilities, about	13.01
Net assets, about	$1460.00

a net increase of $103 over the net assets at end of 1885. These assets do not include, of course, the value of the library and furniture.

MEMBERSHIP.

	HON.	COR.	ACT.	ASSOC.
At end of 1885	3	5	423	8
Additions			41	1
			464	
Deceased			4	
			460	
Resignations, etc			9	
At end of 1886	3	5	451	9

Net increase of Active Membership 6⅔ per cent.

RESIDENCE OF ACTIVE MEMBERSHIP.

Philadelphia		224
Pennsylvania (outside of Philadelphia)	100	
New York	32	
Virginia	14	
New Jersey	14	
26 other States, etc	61	
Foreign countries	9	227
		451

The Tellers of Election, Messrs. Wilfred Lewis and John S. Muckle reported that 165 votes had been cast and that the following were elected Active Members of the Club: Messrs. Arthur Falkenau, Theodore L. Welles, Sydney W. Arnold, J. J. Tierney, Benjamin Franklin, James M. Dodge, S. S. Evans, W. S. B. McCaleb, Edward H. Brown, Alexander Wurts and Robert A. Shillingford; and that the following had been elected

OFFICERS FOR 1887.

President, Thomas M. Cleemann; Vice-President, Joseph M. Wilson; Secretary and Treasurer, Howard Murphy; Directors, John T. Boyd, C. W. Buchholz, Frederic Graff, Washington Jones, M. R. Muckle, Jr.

President elect Thomas M. Cleemann, in taking the chair, said:

Gentlemen, I thank you very much for this honor. In the discharge of my duties I shall endeavor to merit the confidence that you have reposed in me, and I trust that the close of my administration will see the Club in an even more prosperous condition than it is in on my entering it. It has had no vicissitudes as yet, and when I reflect on the worthy men who have preceded me, whose portraits look down upon us, how their government has placed us where we are, I feel some difficence in following them, and I shall perhaps need a little indulgence from you to aid me in keeping up our high previous standard. We have been distinguished, I think, from other Engineering Societies in our Active Members being younger men, still possessed of the enthusiasm of youth in their profession. This, I hope, will continue. It lies with you, gentlemen, to keep up the infusion of new blood, and each should do his part toward increasing our membership with the brightest of the rising young men, the coming heroes in the conquest of the laws of nature for the convenience of man.

Let us now proceed to business.

Mr. Henry R. Cornelius read a paper relating to the two large Centrifugal Pumps at Mare Island Navy Yard, California, built by the Southwark Foundry and Machine Company.

The pumps, the dimensions of which are 42 inch discharge pipes and 66 inch runners, are each driven direct by a vertical engine 28 inch diameter by 24 inch stroke, and were designed to remove the water from a dock 529 feet long, 122 feet wide and 36 feet deep, with a capacity of 9,000,000 gallons.

After being erected on foundations prepared by the Government, a test-trial was made by a Naval Board, the following being extracts from their report.

At the final trial of the two pumps together, the water was admitted to the twenty-third altar, the dock containing 7,317,779 gallons, being 7 feet above the center of the pumps.

"During a pumping period of fifty-five minutes the dock had been emptied from the twenty-third to 2 inches above the sixth altar, containing 6,210,698 gallons, an average throughout of 112,922 gallons per minute. At one time, when the revolutions were increased to 160 per minute, the discharge was 137,797 gallons per minute."

HOWARD MURPHY.
Secretary and Treasurer.

The Ohio Society of Surveyors and Civil Engineers.

The Eighth Annual Meeting of the Ohio Society of Surveyors and Civil Engineers was held at Columbus, O., on the 11th, 12th and 13th inst. Several new members were elected. The annual address was delivered by the President elect, W. B. Jennings, Chief Engineer, C. H. V & T R. R., and the usual routine business of the meeting was transacted on the 11th. In the evening of the 11th a stereoptican exhibition of American engineering structures was given and a paper on "The Oldest Long Span Bridge in Ohio," by C. B. Cook, of Chillicothe, O., was read.

On the 12th E. D. Shreve, Bucyrus, O., read the Report of the Drainage Committee: Jonathan Arnett, of London, O., read a paper on the "Glade Run Ditch;" other papers read or presented for publication in the Annual Report, according to programme, were "Construction of Ditches in Quicksand," by D. P. Hudson, Napolean, O.: Reports of Committee on "Connected Levels," by Prof. C. N. Brown, Columbus, O.; Report on Land Surveying, by J. D. Varney, of Cleveland; Hamilton, O., Water-Works, by T. S. Crider, Hamilton, O.; Sandusky Water-Works, by C. A. Judson, Sandusky, O.; False Works in Iron Bridge Erection, by F. J. Sager, Columbus, O., and in the evening E. H. Mark and Geo. H. Twiss, of Columbus; and Geo. H. Mellin, of Logan, descanted on the "U. S. Signal Service;" "Forecasting Weather;" and "Army Topographical Engineering," respectively while the perennial F. M. Priest was billed for his annual poetical engineering effusion.

On Thursday, D. W. Pampel of Sidney, O., in the Report on Highways, recommended a resolution favoring the abandonment of the State canals by the Legislature. In supporting the resolution, A. R. Geyer gave some personal observations on the old Wabash canal in Paulding county. He claimed the 3000-acre reservoir near Antwerp rendered worthless 10,000 acres of land, which was nothing but swamp from July to December. While the opinion seemed to be that the general navigation of canals was a thing of the past, the society declined to condemn them as worthless. Papers were read by F. A. Bone of Lebanon, on the "Construction of roads under the one-mile assessment law;" J. B. Strawn of Salem on "Fees for County Surveyors," in which he urged that they should be made more definite, and by E. W. Dimock of Ottawa on the "Engineer as a Factor in Civilization."

Secretary Thompson's annual report showed receipts of $463.82 and disbursements of $425.61.

The election for officers resulted as follows: *President*, W. H. Jennings, Columbus; *Vice-President*, D. W. Pampel, Sidney; *Secretary and Treasurer*, Benjamin Thompson, Urbana. *Board of Trustees*—F. J. Sager, Columbus; W. H. Jennings, Columbus; E. D. Shreve, Bucyrus; F. N. Davisson, West Manchester; E. B. Opdyke, Bryan.

The Ohio Mining Engineers.

The seventh annual meeting of the Ohio Institute of Mining Engineers, was held at Columbus, O., on the 13th and 14th. President R. M. Hazeltine of Youngstown delivered his annual address, reviewing the work of the year and the increase in the institute's membership. Professor N. W. Lord, of the State University read a paper on the "Analysis of Blast Furnace Gases," being based upon observations at the Buchtel furnace. The President, who in the capacity of Superintendent of the Ohio Fuel company, had supervision of the construction of several natural gas mains in the eastern part of the State, read a very practical paper on "Laying Gas Mains," and Emerson McMillin, of Columbus, read a paper on "The Iron Ores of Ohio and their Treatment."

In the evening W. H. Jennings, chief engineer of the Columbus, Hocking Valley and Toledo railway read a paper on the "Comparative Results of Weights and Estimates of Coal in the Hocking Valley". George B. Parmele, secretary of the Columbus Brick and Terra Cotta company, illustrated his talk on fire-clays and the applicability of the continuous regenerative gas furnace in burning them, with a chart on which was outlined the tests of clays as to their purities Thomas B. Bancroft, the state mine inspector, in stating the "effect or influence of natural gas on the coal trade," gave some interesting figures in regard thereto. The new fuel was estimated to have taken the place of more than, 3,000,000 tons of coal in 1885, and $21,000,000 of capital was invested in gas wells and lines. It was used in sixty-eight rolling-mills and steel-works, but attempts to operate blast furnaces had not been successful as yet. Mr. Brancroft dwelt at length upon the Findlay gas district and experiments that have been made, but concluded that there was no immediate danger of King Coal being dethroned. In the discussion which followed Professor Orton, referring to the instability of natural gas, said he believed it to be "John the Baptist" leading on to better things in the fuel line.

Engineers' Club of St. Louis,

Meeting of January 5, 1887. The special order of the day was a paper by T. T. Johnston, on "The Great Water-way to connect Lake Michigan with the Mississippi river, and its influence on floods in the Illinois river." It, proved of considerable interest, and was discussed by Messrs. R. E. McMath, J. A. Seddon Holman and Ockerson.

Massachusetts and New Hampshire Boundary Line—Tall Signal Poles.

Observations upon the North Star in the Daytime.

Probably there are some of your readers engaged in the practical operations of Surveying and Civil Engineering, who are not aware of the fact that a true meridian can be fixed in the daytime, by observing the North Star, when at its greatest Eastern or Western elongation.

Having been engaged, during a portion of the past season, in the work of running a part of the Massachusetts and New Hampshire Boundary Line, opposite the Merrimack river, made up of a series of broken lines varying in length from one to four miles, and desiring to check the angles taken at the intersection of the several courses, I have recently reviewed the distance passed over, and determined the true bearing of each course, from observations on the North Star, at its greatest elongation, commencing in October, when the star was in this position about 5 P. M. and continuing it from day to day until the 24th of November, at which time I saw Polaris distinctly at 1.35 P. M. through the telescope of an ordinary engineers transit instrument, manufactured by Buff and Berger of Boston, erecting eyepiece, magnifying twenty-five diameters.

Never having read or heard of anything of this kind being done before, I would like to inquire if any of your numerous readers have been accustomed to fix their meridians in this manner.

In order to avoid the trouble and expense of running random lines between the several monuments, over land more or less heavily wooded, I have had recourse to tall signal poles made telescopic, and with which we very easily elevated flags 100 feet above the monuments, some of which were located in thickly wooded swamps and scarcely visible from a distance of 100 feet without first clearing the ground. Before attempting to run a line one of the tall signal poles was erected at each end of it, then by going on some elevation in the vicinity, where both signals could be seen, the range of the line was very easily obtained, and projected through from monument to monument, a corps of axemen opening vistas through the trees, so that generally a sight of both signals could be obtained from some point in line between them.

Fifteen different courses, about twenty-one miles all told, have been run and marked on the ground between the monuments now standing at the several angles in the line.

This line extending from the "Boundary Pine" monument so called, opposite Pawtucket Falls in the City of Lowell, to Brandy Brow hill at the north easterly corner of the city of Have hill, intersects in its several courses one church, four dwelling houses, several other buildings and three shade trees, yet every important point has been located on the ground from the instrument standing in exact alignment between the monuments, the entire distance having been run without randoms, or any offsets whatever, only for measuremen s around the buildings.

Measurements for the purpose of fixing the location of roads and property lines, have been made with a steel tape 250 feet long.

More than ordinary care has been bestowed upon this work, in order to ascertain how near tape measurements can be made to agree with the triangulation work executed by Professor Quimby, surveyor on the part of New Hampshire, who has spent the past season locating the boundary line monuments in connection with other points along the bank of the Merrimack river, from Lowell to the ocean, so that when his calculations are completed they will check all errors made in the tape measurements.

On one line about two miles in length, the tape measurements differed only 3 feet from Borden's triangulation figures made forty years ago.

The object of the present survey is to locate the line on the ground between the several monuments, and to obtain the necessary data for a suitable map and description of the line, to be placed on record, and also for the purpose of ascertaining in what manner, and how much said line differs from that intended by the original decree of 1740 which calls for "a singular curve line pursuing the course of the Merrimack river, at three miles distance on the north side thereof, beginning at the Atlantic Ocean and ending at a point three miles due North from Pawtucket Falls."

The validity of this old decree, issued by the King in council nearly a century and a half ago, is probably one of the interesting questions to be decided before this controversy is closed, although the fact that the government of Great Britain has not been called upon to ratify boundary line agreements that have been made between any of the States, since the Declaration of Independence, would seem to be conclusive upon that point; still one of the parties to this controversy claims the decree, notwithstanding all the events that have transpired since its original promulgation. I shall endeavor to keep your readers informed of the progress of this work.

N. SPOFFORD.

HAVERHILL, MASS., Jan. 15, 1887.

TRADE NOTES.

The most encouraging feature in the present commercial and industrial situation is the existence and steady growth of a conservatism that promises to protect us against a reaction. The basis for the present strong prices and active demand in all branches of industry and trade, is the extraordinary railway construction of the past year and the assured heavy construction of the present year. In a word the country's requirements are ahead of supply and in the opinion of good authorities everywhere, the supply will not overtake the demand for perhaps a year to come. In fact, if the proper trade and financial conditions can be maintained it is a question whether the overproduction of past epochs can be repeated. A broad view of the situation obliges us to assert that the legitimate consumptive requirements of the country are far beyond any point they have ever yet reached. The overcrowdings have been the result of diseased conditions and imperfect methods and deficient systems. Overproduction is not possible so long as requirements are not filled. The world has learned a great deal of wisdom commercially, financially and industrially during the past ten years and much of this new learning is now or soon will be put in to practice. Capital desires constant and remunerative employment. Enterprise is anxious to avoid the disasters which have heretofore upset it. Labor is solicitous of constant employment and good wages. The accumulated energy of the country calls for regularity in production and exchange and in the constant broadening of opportunities. A higher statesmanship is needed and is being established, for instinctively the whole people are learning just how little and how much they know of the great causes which underlie a nation's or a people's growth. The business of the past year has been phenomenal. Its volume was larger than even the longest-headed merchants and manufacturers anticipated in the early months. The real activity began in September but the basis for it was laid a year before. We are now laying a basis for a prosperity that will not develop itself in commercial channels until, at least, a year hence, and the volume and character of that activity will depend upon the manner in which we now do our work. The reasons for the great activity in railway construction last year are familiar to all. The laying of over 8,000 miles of track, to be followed this year by the construction of ten or twelve thousand miles more, at least means something more than the mere construction of 20,000 miles of track in two years. This activity has created an unusual demand both at home and abroad and prices under this stimulus have advanced from four to five dollars per ton for steel rails, old rails, rail blooms, billets, slabs and plates. The apprehension now entertained by a great many is that this advance is not the last and that the impetus that has been given may overdo this by scaring off enterprise which is always a raid of unduly high prices and which is attracted into avenues of activity by low prices. Whether the present quotations for railway and building material of all kinds can be maintained is a question which no one is competent to decide upon so far in advance. The rail makers have sold eight to nine months' production. The rolling mills are sold from three to four months ahead. The pipe makers are unable to meet the urgent requirements of their customers. Importers have been unable for weeks past to supply old material as fast as rolling mill managers desire supplies. Prices have been steadily advancing since September. A feverishness overtook the market in the month of December. Just at this time it is impossible to predict which way the influences at work will carry us. Manufacturers and the controllers of our industries and of transportation know that speculative values are disastrous; that in times past they have caused reactions which produced results that it took years to eliminate. The best opinion is that we have reached as high a range of prices as we are likely to reach. Steel rails which were sold early in December at $34 can be sold to-day at $38 to $39. The capacity of the mills is estimated at from 1,700,000 to 1,800,000. If the estimates are correct that over a million and a quarter tons have been already contracted for it leaves something in the neighborhood of 600,000 tons yet to be sold and if the announcements of railway and other journals are correct as to the amount of construction requirements yet to be taken care of this year the unsold will be totally absorbed long before midsummer. It is not therefore surprising that rail makers, bar iron makers, steel makers, pipe and bridge iron makers and iron and steel makers of all kinds should inaugurate a policy of holding back in order that they may be able to see where prices are going to and what is the probable outcome of all this feverish activity.

Agents of foreign iron and steel makers are at present among us observing and reporting. Brokers are cabling and but for the high prices of the past thirty days they would be able to close contracts by this time for large supplies of Bessemer pig and the various kinds of furnace products which are raw material for our rolling mills. Old iron rails are selling to-day within a few cents of the prices at which new steel rails sold a few months ago. Old material of all kinds has advanced in prices. Nails have advanced to $2.40 in the East, and $2.60 in the West. The production in iron advanced 4,000 tons per week during the month of December and the total capacity now is about 128,000 tons per week. All interests connected with railway activity are similarly prosperous. Within a few week orders or inquiries have been made for somewhere over 1,000 locomotive engines and for the supply of rolling stock, concerning which only foggy estimates can be made. Nearly every company in the country ought to have more cars and a large number of them have contracts in hand for rolling stock. It is probable that the car builders will be crowded with orders throughout this year. The car wheel makers, axle makers, merchant steel manufacturers and the manufacturers of machine shop masonry and all kinds of heavy tools will have about as much business as they can conveniently handle for four or six months to come.

The financial conditions of our railroads and of our leading industries are satisfactory. While it is true that a considerable percentage of railroad mileage has been tossed on the sea of bankruptcy and receivership, it is also true that there is a better condition of railway property generally than heretofore. The improving prospects for traffic and the prospects for the maintenance of friendly relations between our various railway interests are better. In fact, the railroad interests are on a firm foundation and all of the multitudinous interests identified directly and indirectly with them may expect to profit by the activity which follows in the wake of a healthy railway activity.

WATER.

PORTSMOUTH, VA.—The water-works will be sold March 31st, 1887. For particulars address C. H. Causey.

STEUBENVILLE, O.—Plans for a sewerage system have been made by Rudolph Hering, C. E., of Chicago; there will be pipe sewers. Work will be commenced this spring. Address the city clerk.

WATER METERS.—From the 12th Annual Report of the Board of Water Commissioners of Atlanta, Ga., dated Dec. 31, 1886. On page 13, Mr. W. G. Richards, Supt., states "I cannot close this report without again mentioning the very gratifying results that have been obtained through the universal use of meters. The waste has been stopped, the pumpage has been reduced to about one-third what it was prior to their introduction, the consumption of coal is also about one-third of what it was, we are enabled to give the firemen all the pressure wanted or required, we have been enabled to get the pumping machinery into splendid condition, we are carrying a uniform domestic pressure that is giving satisfaction at the highest altitudes in the city, and affording all the pressure required for the hydraulic elevators; the rate of insurance has been reduced and the insurance underwriters are pleased with the uniform efficiency of the works. There are no complaints or grumbling except the regular monthly growls from those who have to pay for neglect or careleSness in the shape of a big water bill. Whatever merit the water works has, is due to the meter system and the Board of Water Commissioners, aided by his Honor the Mayor, who displayed the nerve to require their universal introduction, and thereby save the water works from becoming a wreck."

ARAMINGO CANAL.—The Councils Survey Committee, Philadelphia, Pa., has been considering the future usefulness of the canal in the northeastern section as a great sewer for the 22nd, 23rd and 25th wards. The Board of District Surveyors reported that the present canal bed is a pest hole prejudicial to health and difficult of drainage, being below high tide. A recommendation was added that the lines and grades of the streets along its route be revised, with a sewer built to carry off the refuse matter, and that an 80 feet avenue also be constructed from Huntingdon street to Frankford creek, about two miles. The Chief Engineer and District Surveyor said that the canal is partially used by business firms for a short space below Huntingdon street and the much dreaded question of riparian rights might involve the city in great damages. For this reason the Chief thought that it would be eminently proper for a slow progress, and the work ought be started at the lower end of the canal to avoid legal complications. The report was adopted.

MANCHESTER, N. H.—The Board of Water Commissioners has presented its annual report to the council. The expenditures have exceeded the income by $9,733.49; this is owing to a reduction of the rates and to large expenditures for the new pumps. The price for metered water was changed one year ago from 20 cents to 15 cents per 100 cubic feet, and the use of the meters was made free; this appears to have given general satisfaction, and there are no complaints as to the present rate. In January, 1886, proposals were invited for a pair of pumping engines with a capacity of 5,000,000 gallons per day; six proposals were received, and the contract was awarded to the Davidson Steam Pump Co., of Brooklyn, N. Y., for $11,700; the pumps are now in use, and though the specified tests have not yet been made, owing to the low stage of the water and the imperfect working of the wheels, they have given entire satisfaction. It is recommended that the water wheels, which have done good service for 13 years, should be thoroughly overhauled or replaced by new ones. The outlay for the current year is not expected to be as large as for 1886 but the cost of maintenance will naturally increase with additional service. In conclusion the commissioners state that the works, as a whole, are in satisfactory condition and are admirably answering the purposes for which they were constructed.

BROOKLYN, N. Y.—The Department of City Works has raised the banks and closed the waste weir at Baiseley's Pond, near Jamaica, and during the shortage of supply last week, had engines pumping the water direct into the conduit. By this means the daily supply is increased by from 2,000,000 to 5,000,000 gallons. While the consumption during the cold weather was about 58,000,000 gallons daily, less than that was pumped into the distributing reservoir at Ridgewood. On January 10th, the quantity pumped was 53,946,344 gallons, while the actual consumption on that day was 58,876,099 gallons. On the corresponding day of last year the consumption was 51,164,527 gallons.

CHICAGO, ILL.—It is proposed to have a pumping station erected on the South Side, at a cost of about $200,000. City Engineer Artingstall states that at least four new pumping stations will become a necessity within a few years. One is needed on the South Side at present and others will be necessary on the North Side, or in the northwest section of the city and another in the business part. In the district between the rivers, east of the lake and north of Van Buren street, the locality in which motive power is most required, fully 90 per cent. of all the water is consumed. The present supply is simply a domestic one and extensions are greatly needed. Commissioner of Public Works Purdy concurs in this opinion.

SYRACUSE, N. Y.—Engineers H. D. L. Sweet and Eugene Bogardus have submitted their report to the Salmon River Water Co. The watershed of the east branch of the Salmon river embraces eighty-four square miles or 53,760 acres. Eighty per cent of this is woodland, eighteen per cent. pasture and meadow, with only two per cent. under cultivation. There are 120 houses on the watershed and the total population is a little under 500. The quantity of water available for storage that falls within its area annually is 26,345,088,000 gallons, that is, figuring the amount that can be stored at not more than one-half the total rainfall. The site of the proposed reservoir is in the town of Redfield, Oswego county, and the town of Osceola, in Lewis county. This is some five or six miles above the falls of the river. The land above Redfield is found to be far better adapted to the construction of a reservoir. The report states that the proposed reservoir will embrace 1,150 acres, the bottom of the valley being 550 feet above the level of the canal at the swing bridge. The reservoir at its highest point will be 70 feet above this, with 64 feet depth of water. The water, therefore at the surface will be 614 feet above the swing bridge level. It is proposed that the gate in the dam be 30 feet above the bottom, this giving 850 acres of reservoir surface at the line of the settling basin, while at the top the water surface will be about 1,000 acres. The storage capacity will be 9,555,975,000 gallons, the capacity of the watershed being ample to fill the reservoir three times a year. In fact, the storage capacity will be enough to supply the city with 15,000,000 gallons a day for 637 days, or 20,000,000 gallons for 477 days, or 60,000,000 gallons daily for six months. The report proposes a conduit of cast-iron pipe 36 inches in diameter. The distance from the reservoir to Brewerton is 26.5 miles, and from Brewerton to the proposed reservoir in the Eighth ward, 14.5 miles. The estimates include a reservoir in that ward with a capacity of 15,000,000 a day for 26 days. The cost of the work is estimated to be:

Reservoir on Salmon river	$ 439,920
Distributing reservoir, Eighth ward	209,400
41.5 miles 36-inch pipe	1,794,000
	$2,443,320

This estimate does not include the laying of distributing mains in the city, which would cost, it is said, $500,000 for double the number of miles owned by the Syracuse Water Company. The engineers are of the opinion that liberal allowance is made for every contingency. No sum is named in payment of damages to mills on the stream, below the falls. Mr. Sweet says that there is only a very brief season in the year when it will leave them short of water if a dam is built on the south branch of the river, and that the supply in store at the reservoir will more than make them good when the stream is low. The trustees of the Salmon River Water Co. have voted that, if the stream is taken by the

city and works are built, all the rights, franchises and property of the company shall be turned over to the city for a sum representing the money actually spent by the company, this sum, however, not to exceed $5,000.

STAR WATER METER CO.—The company has been incorporated at Portland, Me., to manufacture water and other meters. President, Wm. W. Kellett; Treasurer, Samuel S. Sies.

GAS WORKS.—Asheville, N. C. A gas company has been organized, with a capital of $30,000; the New York Contract Co. furnishes half the capital and will have the contract for constructing the works; work will be commenced in March; address C. M. McLoud.——Dunham, N. C. A gas company is being organized; address; M. W. Reed.

THE GREAT WESTERN R. R. Co. (England) will try to utilize the 14,000,000 gallons of water per day coming from the Sudbrook Springs. It now costs about $50,000 per annum to pump it into the Severn. The water is pure spring water, entirely free from organic matter and fine for domestic purposes. The present project is to supply it to Bristol; a company is being formed with a capital of $2,400,000.

THE City Commission of Sewers, of London, have decided to legally test their powers as to sinking artesian wells in London, and so be independent of the water companies. They believe wholesome water can be obtained in abundance from a point far below sewage contamination and at a cost for each well of about $10,000.

WOODSTOCK, VT.—T. William Harris, contracting engineer for public works, 19 Exchange place, Boston, Mass., has made a contract with R. D. Wood & Co., of Philadelphia, for the construction of the water-works; R. D. Wood & Co. recently took the contract from the Woodstock Aqueduct Co. The work consists of a dam 19 feet high, and seven miles of pipe from 4 to 10 inches in diameter. The village is the summer home of Hon. Frederick Billings and other rich men who take an interest in the welfare of the place. The works will be first-class in every respect.

ROCKLAND & ABINGTON, MASS., WATER WORKS, CORRECTION.—In an article published last week in ENGINEERING NEWS on page 50 *ante* describing above works, the statement was made at the close of the article that the Water Works Committee refuse to pay the demand of the contractors, Messrs. Thomas F. Maney & Co., for certain extra work claimed. The contractors write us that the statement that the committee refuse to pay is untrue; they have not refused. In justice to the contractors, we make this correction. ED. ENGINEERING NEWS.

NEW WATER-WORKS.—Lamar, Mo. A committee has been appointed to consider the question of water and gas works.——Hiawatha, Kan. A test well struck a flow of water at a depth of 22 feet.——Cleveland, O. Six new boilers are to be put in at the West Side pumping station; $75,000 will be applied to the water-works.——Bath, N. Y. The contract has been completed with Bassett Bros., of Buffalo.——Sing Sing, N. Y. The water supply question is being agitated; the Croton river or Collabaugh pond will be the source, the latter is 50 feet above the village.——Macon, Ga. The well water being unhealthy many of the pumps are being taken up. The company supplies good water and wants to contract with the city for 20 years, the city wants only 10 years.——Chautauqua, N. Y. Plans for water-works have been made by Homer D. L. Sweet.——Marshall, Tex. A company will shortly put in works at a cost of about $45,000; stand-pipe and direct pressure; daily capacity 500,000 gallons.——Huntington, W. Va. Works will be built by the American Water-Works & Guarantee Co., McKeesport, Pa.——Albert Lea, Minn. The city will purchase the water power of Fountain lake for $4,500.——Delaware, Ill. A tank to hold 500 barrels of water is to be erected and a steam pump put in.——Fairbury, Ill. Work will be commenced this spring.——Augusta, Ga. City water-works are projected.——Newark, N. J. The authorities will introduce a bill in the next Legislature to authorize the issue of bonds for a water supply.——Vicksburg, Miss. The surveys are about completed and construction will soon be commenced.——Dover and Foxcroft, Me. A stone dam will be built across the Piscataquis river by the water company.——Galesburg, Ill. The demand for water has been so great that parties have been hauling it from a large reservoir.——Columbus, O. An increased supply and an additional pumping station are recommended.——Pittsburg, Pa. The city has put a pump at the Hazlewood reservoir and now supplies plenty of water to that neighborhood.——Bolivar, Mo. The ordinance has been passed granting a water company a franchise for 20 years.——Braintree, Mass. The town has voted to buy the franchise of the water company.——Salem, O. Judge J. A. Ambler is interested.——Key West, Fla.——Tuscumbia, Ala.——Perry, N. Y.

CONSTANTINOPLE WATER WORKS.—Frederic Briffault lately read a paper before the Institution of Civil Engineers on these works. The city of Constantinople is divided into two portions by the Golden Horn; Galata and Pera, the European quarter, is on the northern side and with rear villages has a population of about 360,000 souls, with the highest section 370 feet above sea-level. Stamboul, the old city, has about 420,000 inhabitants and the highest ground is about 260 feet above the sea. Deducting a floating population of abont 5,000 souls, we have then about 785,000 persons as a total population to be provided for.

The city is now supplied by reservoirs, on a spur of the Balkan mountains, from which the water is conveyed by aqueducts built by the later Roman emperors. The main works reflect credit on the builders, but the distribution is very faulty. The pipes leading from the small service reservoirs in the city are of lead ranging from 0.98 to 2.36 inches in diameter; these pipes are very thin and easily damaged, and in many houses discharge into marble cisterns, occupying the whole basement and in which rain-water is also collected. The annual rainfall, from observations extending over a serious of years, is 28 inches; but in a dry year not more than 5 inches can be collected.

In 1882, a French company with $4,000,000 capital undertook to bring water from Lake Derkos near the Black Sea; a lake 12 feet to 20 feet deep, covering 10,000 acres and cut off from the sea by sand dunes. Water is taken from this lake by a tunnel to the village of Derkos, twenty-nine miles from Constantinople; here three high-pressure horizontal direct-acting engines of 600 H. P. drive two double-acting piston pumps capable of delivering collectively 4,400,000 gallons of water 410 feet high in 18 hours. The water is lifted 358 feet high in a 24-inch pumping main, 2.17 miles long, to a reservoir near Derkos of 1,043,500 gallons capacity. This reservoir is in four compartments arched over. From this reservoir the water flows by gravitation through a built aqueduct and siphon-pipes a distance of 26.66 miles to the service reservoir on the high ground at Pera, 295 feet above the sea. Fifteen valleys are crossed, on the way to Pera, by 24-inch cast-iron syphons, aggregating 6.6 miles in length; the aqueducts and tunnels are twenty miles in length.

Within the city the distribution pipes vary from 13.8 inches to 2.4 inches in diameter; the prices paid for laying and jointing the pipe (exclusive of excavation and back-filling) ranged from about 30 cents per lineal foot for the 24 inch pipe, to 3.4 cents for the 2.4-inch pipe. The many erratic sewers, or more strictly speaking the elongated cess-pools, of the city made this pipe-laying very difficult. All water supplied is metered and the charge is about 67½ cents per 1,000 gallons; special arrangements are made for the few large consumers. The average cost of the aqueduct was about $6 per lineal foot; the engines and boilers cost $120,000, and the total cast-iron (mains, distribution and specials) aggregated 9,340 tons. At present 4,000 houses in Pera are supplied with about 50,000 gallons per day.

MONTCLAIR, N. J.—At the meetings of the Township Committee on January 11th, to open bids and consider plans and specifications for a water supply, six bids were received. The Montclair Gas & Water Co. declined to bid. Capt. H. G. H. Farr, of Montclair, representing a New York syndicate, proposed to lay twenty miles of pipe in Montclair and Upper Montclair; to sink driven wells sufficient to supply 1,000,000 gallons of water per day; to erect pumping station; put in two Worthington duplex pumps; construct and keep filled a reservoir, and erect 175 hydrants upon the twenty miles of pipe, the township to pay an annual rental of $35 per hydrant. The township to give the company the exclusive franchise to supply water for twenty years but the town to have the right to purchase the works at the end of ten years at the appraised valuation. Water for all public buildings, four public hydrants and for flushing sewer pipes to be furnished free of charge. He agreed to sink ten experimental wells in different portions of the township in order to determine the best source of supply, both as to quantity and quality. If the contract should be awarded this month, he will have water in the township by July 1st, and the works entirely completed by September 1st. The works will be constructed with the idea of ultimately taking the water from the proposed mains of the North Jersey Water Company.

Mr. Frederick M. Wheeler, of Montclair, representing Messrs. Turner, Clark & Rawson, of Connecticut, proposed to sink driven wells in such place as the Township Committee might designate, sufficient to supply 2,000,000 gallons of water per day; to build pumping station and erect duplex high pressure pumps; to build a reservoir or erect a stand-pipe; to lay thirteen miles of mains, erect not less than 100 double-nozzle fire hydrants; to furnish water free to public buildings, five public hydrants and public schools for an annual rental of $29.80 per hydrant. Additional hydrants to be erected at an annual rental of $24.80 each, and one hydrant to be erected for each 400 additional feet of mains laid. The township to give the exclusive franchise for twenty years, but to have the right to purchase the works at an appraised valuation at the end of ten years. Work to begin within thirty days after the awarding of the contract and to be completed by October 1st next.

Messrs. Samuel R. Bullock & Co., of New York City, presented a bid, through Mr. George W. DaCunha, to lay twenty miles of pipes, erect 200 double nozzle fire hydrants, build pump-house, put up two pumps and supply 1,500,000 gallons of water from a source approved by the Township Committee; to build a reservoir or erect a stand-pipe; for an annual rental of $35 per hydrant for the first 200, and $30 each per annum for all additional hydrants over that number. The committee may have erected any additional number of hydrants in additional to the 200 on the twenty miles of pipe, at their own expense, and water would be furnished free to them. Water would also be supplied free to churches, public schools and buildings, for the public hydrants and for fire practice by the fire companies. The company would sink test wells, agree to have $30,000 worth of work done within sixty days after the awarding of the contract, and would sell to the township at the end of ten years.

John R. Bartlett, representing a Paterson syndicate, proposed, if given the contract, to organize a company within ten days and introduce the best system of water supply obtainable, 100 fire hydrants to be erected, for an annual rental of $40 per hydrant. The estimated cost of building the works and supplying water by the driven well system was $110,200 and Mr. Bartlett offered to give bonds to sell the entire works to the township for the exact cost, together with interest, any time within three years after the completion of the works.

William S. Wallace, representing the Montclair Water-Works Company, a prospective corporation, proposed to lay any any number of miles of pipe, not less than six; to secure water from driven or surface wells to secure sufficient pressure by a reservoir stand-pipe or direct pumping, as in East Orange, and to put up not less than ninety hydrants, the township to pay an annual rental of $3,150. An additional six miles of mains would be laid and ninety hydrants erected for $2,700.

Francis M. Eppley, of West Orange, as attorney of a water supply company, proposed to lay eight miles of pipe, erect 100 fire hydrants, 422 feet apart, for an annual rental of $3,500, or to lay fifteen miles of pipe and erect 200 hydrants, for an annual rental of $5,200. The water to be obtained from driven wells and all the necessary plant erected. The company to have the exclusive franchise for twenty years; the right to transfer the contract to a local corporation to be organized, and the town to have the right to buy at the end of ten years.

The Committee announced that they would require time to look over the bids and compare the plans and estimates.

UTILIZATION OF SEWAGE.—The new system of drainage which disposes of the sewage from the county buildings at Brighton, Monroe county, N. Y., is in full operation. The plans were made by John C. Ryan. A line of tile pipes was laid from the rear of the penitentiary to a point about 2,319 feet distant, where two reservoirs were built. This line of pipes, which formed a sewer, was laid in the rear of the alms-house and insane asylum, and was connected with each building by laterals. In constructing the sewer the general direction of the ridge on the land was followed so that a sharp fall was secured. The grade from the penitentiary to the reservoirs varies from about one foot to four feet in 100 feet. From the alms-house to the reservoir 12-inch pipes were used; and 6-inch pipes from the penitentiary to the alms-house.

The reservoirs are 80 by 30 feet; when one is filled, the sewage is turned into the other, that in the first one being worked into compost, and used as fertilizing material on the county farm. At the end of each of the reservoirs is a sieve through which all soluble matter passes into a second system of 6-inch tiles. These pipes lead to the southeast end of the county farm 1,142 feet distant. The discharge flows into a field where it will soak into the ground and act as a fertilizer. The pipes are arranged that the waste may be turned first into one field and then into another. These fields are at a considerable distance from the road, and if a slight odor should arise it will not cause annoyance.

The work has been well done with the exception of the reservoirs, which are temporary and answer tolerably well for the present. Supervisor Hobbie personally supervised the work and is satisfied that the vexatious problem of sewage disposal has been solved. The cost of completing the system seems trifling in comparison with its benefits. The labor was for the most part performed by inmates of the institution, and the cash outlay will probably not exceed $1,000.

The system is one in which a large number of citizens of Rochester are interested, from the fact that it has frequently been stated that the city would in time be forced to adopt some such plan on a large scale in

order to settle the sewer questions which are daily becoming more serious.

ATTLEBORO, MASS.—Last fall the question of obtaining a larger and better supply of water was considered and a water committee appointed. Engineers M. M. Tidd and P. M. Blake were engaged to investigate the matter and have made surveys and a report. Mr. Tidd estimated the cost for 11,545 feet of 12-inch water pipe at $17,317.50; an earth and masonry reservoir with a capacity of 1,500,000 gallons, $13,000; a compound duplex pumping engine and boiler, $7,500; the total estimate, including coal, oil and waste, incidentals and 10 per cent. for contingencies, is $48,199.25. Mr. Blake states that the requirements are a greater and more reliable supply, increased pressure, increased pumping capacity, greater reservoir storage capacity, larger mains and more complete circulation. His estimate is as follows: Pumping station and coal shed $5,000; one compound condensing pumping engine, capacity 1,000 gallons per minute, against 189 feet head, with one boiler and connection, $7,500; collecting well, $8,000; suction pipe connections $1,500. Total cost of source, $22,000. Reservoir, 1,750,000 gallons, $12,000: 5,000 feet 12-inch force main, 90 pounds per foot, 205 tons at $32 per ton, $6,560: laying same at 40 cents per foot, $2,000: 4281 feet 12-inch leading main, 85 pounds per foot, 165 tons, at $32 per ton, $5,280; laying same at 40 cents per foot, $1,712.40; 4,919 feet of 14-inch leading main, 100 pounds per foot, 220 tons at $32, $7,040; laying same at 50 cents, $2,459.50; special castings and connections, $1,000; ledge excavation on leading main $1,000; total $61,051.90. The cost of operating and maintaining the works when these improvements are made will be about as follows: Allowing a consumption of water equal to 200,000 gallons per day, and that pumping is done intermittently, then the coal consumed will be about 120 tons per year at $5, $600; oil, waste and repairs, allow $190; engineer's salary $1,000. Allowing machinery and boiler to be good for fifteen years constant service, then for depreciation of plant allow 1-15 of $7,500, $500. Allowing cost of improvement to be $60,000; then four per cent. interest will add annually $2,400; installment to sinking fund to retire loan incurred $1,000, making total annual expense $5,600.

NEWS OF THE WEEK.

Railroads, Bridges and Canals.

The Piling Protector Co. has been incorporated at Brunswick, Ga., by John T. Collins, W E. Kay, and others; capital stock, $125,000. The purpose is to operate a patent to protect piling and to build wharves.

The Panama Canal.—According to the *Bulletin* the total excavation for November, 1886, was 855,000 cubic metres; mainly at Gatun, Obispo, Emperador and La Boca.

Central Electric Elevated Railroad.—The council committee on railroads, St. Louis, Mo., has authorized F. A. Mann and others to construct this road; it is claimed that as the cars would not exceed 6 feet in width they would not be an inconvenience in the 15 feet alleys.

St. Louis Bridge, Fair Ground & Forest Park Elevated R. R.—Mr. Samuel Cupples, who is the leading member of the company, states that the plans and specifications have been prepared, and if the franchise is granted soon the road can be in operation by October.

St. Clair Tunnel.—The work of sinking the shafts of this tunnel from the United States to Canada at Detroit, Mich., is progressing. On the Canadian side of the river the shaft is down 60 feet, and on the United States side 40 feet. The material is a stiff blue clay.

Storm King Bridge.—The New England & Southwestern R. R. Co., of which Gen. James W. Husted is President, reports that it will commence construction in sixty days and have the bridge completed in eighteen months. The estimated cost is $5,000,000, and General Manager Snow states that the Phœnix Bridge Co. has taken the contract.

British Defences on the Pacific Coast.—The Canadian Pacific R. R. Co. has been notified that twelve 80-ton guns for the defense of Victoria, B. C., are under construction in England, and will be ready for shipment in April. The drawings for special cars have been furnished and the cars are being built by the company. Large quantities of war material will arrive with the guns.

The French Railroad Jubilee Exhibition, to be held in Paris from May to October of this year, will occupy about 900 acres of the Bois de Vincennes, at the Paris end. About nine miles of railroad tracks will be laid. Some opposition is shown to the enterprise by promoters of the Paris exhibition of 1889. The English press credit American exhibitors with being very active and intending to make a very full and interesting exhibit of railway appliances. It is to be hoped that this is the case.

The Reported Victorian Rail Contract for 50,000 tons of German rails at a little over $20 per ton is not pleasant reading to the English manufacturers, says *Iron*. The price is f. o. b., and it is thought that cheap freight by German steamers has something to do with the matter. *Herapath's* thinks the Colonial authorities might have strained a point and taken English rails, "even at a little extra price."

Mexican Railroads.—Work will commence on the Mexican National R. R. in May, to complete the line from Saltillo to the City of Mexico; 400 miles of road will be required.——On the Mexican International R. R., about 80 miles of road have been graded and tracklaying is progressing at the rate of a mile a day southward for Castrano; it is expected to reach the Mexican Central R. R. at Laredo by February 1st.

The Proposed Syrian and Persian Canal.—M. Eude, a French engineer, has just laid before the Academy of Sciences a project for cutting a canal through Syria and Persia and thus unite the Mediterranean with the Persian gulf. He would start from Antioch, pass up the Orestes, tunnel through the mountains to the Euphrates and follow that river to Babylon; then to Bagdad by canal; finally down the Tigris and Chat-el-Arab to the Gulf. The cost is not even estimated, and the only advantage named is the shortening by three days of the route from Europe to Asia.

Asiatic Railroads.—According to *Herapath's*, the Imperial Ottoman R. R. was originally built to connect Smyrna with Aidni, 81 miles distant. Within the last four years it has been extended to Seraikeny, or 145 miles of main line and 32½ miles of branches, to Thyra, etc. The net profit in 1885 was $504,520. The main line of the Smyrna & Cassaba R. R. is 105 miles long; it was opened in 1875, and earned a profit of $386,515 in 1885. Two magnificent railroad schemes for India are before the public; one, the famous Euphrates Valley line, to unite the Persian gulf with the Mediterranean, is regarded by *Herapath's* as a danger rather than an advantage, as Russia is now at Kars, in a few years may be at Diarbekr, and would be within easy reach of any Euphrates valley line. The second project is a railway from Candahar to Herat, to there connect with a Russian through line. The editor thinks this scheme more perilous than the first; as it would open a direct route to India for the doubtless ambitious, and apparently suspected, if not feared, Russ. *Herapath's* thinks that a railway from Quetta to Herat would simply be a waste of Indian money and an advantage to Russia.

Bridges.—At Omaha, Neb., an elevated structure is to be erected by the Union Pacific R. R. for switching purposes; bridge abutments are being erected wide enough for 16 tracks; the Morse Bridge Co. is putting up some of the works.——At Detroit, Mich., Messrs. Donaldson & Meier, architects, will build a bridge across the canal at Central avenue; it will be 80 feet in length; and will have a 50 feet roadway and two 14 feet sidewalks.——A swing bridge is to be erected over the Erie canal at Ithaca, N. Y.; address Thomas E. Kinney.——At Rochester, N. Y., a bridge is proposed to be built across the Genesee river at Elmwood avenue, in Brighton, to Chili.——An iron bridge is to be built across the Potomac river at Williamsport, Md.; address John Dugan.——At Detroit, Mich., the city attorney has given an opinion that the Bureau of Bridge Construction, organized last August by a resolution of council, and composed of members of the Board of Public Works and the Park Commissioners, is not a legally constituted body; the charter will be amended to legalize the bureau.——A bridge is to be built at Franklin avenue, Minn.

Street Railroads.—Vanderbilt & Belmont Avenue Street R. R. Co., Nashville, Tenn.; D. Eve, H. G. Gwyn, S. Hill, and others; horse traction will be employed, with dummies on the steep grades.——Sheffield & Tuscumbia Street R. R. Co., Sheffield, Ala.; the road will be built at once; address E. B. Almon, secretary.——Atlantic Avenue R. R. Co., Brooklyn, N. Y.; the Park avenue cable line is nearly completed, two Corliss engines have been put in at the driving station and the line will be in operation next month.——Texarkana Street R. R. Co., Texarkana, Ark.; 1½ miles will be built at once and extended as required; Thos. Orr, secretary.——Pensacola Street R. R. Co., Pensacola, Fla.; the road has been purchased by J. F. Shaughnessy, of New York City, it will be extended and improved and will probably be operated by electricity; S. F. Chipley, general manager.——Huntsville Street R. R. Co., Huntsville, Ala.; the rails have been delivered and work will be commenced next week.——Springfield Street R. R. Co., Springfield, Mass.; the Worthington street route has been authorized and will be built this spring.——New York Cable Railroad Co.; an amended charter to the one granted in 1884 has been filed at Albany, N. Y.——Orange Crosstown & Orange Valley Street R. R. Co., Orange, N. J.; the local board has granted power to operate the line by electric motors; the poles are to be 75 feet apart; the Sprague system will be used.——West Division R. R. Co., Chicago, Ill.; it is proposed to operate the lines by electricity.——A cable railroad is to be built between Hamilton & Cincinnati, O.; address S. L. Miner.——Street railroads are to be built at Zanesville, O.; Syracuse, N. Y.; and Durham, N. C.

St. Louis Bridge.—The board of U. S. engineers has reported to the Senate in favor of a high level bridge. They state the following arguments addressed in favor of a low level bridge: economy in construction (estimates prepared by E. L. Corthell); easier connection with the railroads and the union depot; less cost of operating on account of the avoidance of high grades and long approaches; and that by means of a sheer boom the draw would be less of an obstruction to navigation than a wide span. In favor of a high level bridge the following arguments are stated: the shifting nature of the channel might make the draw impassable; the current is stronger at the bridge site than at any drawbridges above, so that the bridge would be a greater obstruction than any now existing; the drift (which is not found in the upper Mississippi) would endanger the control of the tows at the draw; the draw would cause serious delays to railroad and river interests, owing to the frequent passage of trains; the width of the largest draw spans, 200 feet, is not sufficient to permit the passage of the ordinary rafts and tows now reaching St. Louis; the location of the bridge would compel the removal of lumber yards which could not find good locations above; and the cost of a high level would not necessarily be much in excess of that for a low level (estimates prepared by Col. Flad). After considering all these points the board is decidedly of opinion that a low level bridge, with a draw, should not be authorized below the mouth of the Missouri river.

Justice and navigation interests require that the proposed bridge should be no greater tax upon the commerce of the river than is absolutely necessary. Channel spans of 500 feet clear width, giving a clear headway of not less than 50 feet at high water, are the least dimensions that should be authorized, and with the recent progress in engineering and the introduction of the cantilever system it is not expecting too much to suggest that spans of even more than 500 feet may be found to be both practicable and economical. The board desires to emphasize the difference of the Mississippi river below and above the mouth of the Missouri river. Above, it is a quiet river, comparatively free from sediment and drift; the difference between the high and low water does not exceed about 22 feet. Although low bridges on such a stream are obstructions to navigation, they are not intolerably so. Below the mouth of the Missouri all this is changed. The rise and fall increases to 42 feet at St. Louis and over 50 feet at Cairo; the current doubles in velocity; the volume of sediment is vastly increased, drift frequently runs, the bed is constantly shifting. In a word, the river changes its character, and low bridges must be regarded as an intolerable nuisance to navigation interests. The Ohio river, which, in its lower course, resembles the lower Mississippi, is protected by a general bridge law forbidding the construction of low bridges, and, in the judgment of the board, such a law properly adapted to suit the requirements of the Mississippi below the mouth of the Missouri river would be successful legislation in view of the increasing demand for bridges on the lower Mississippi.

Proposals Open.

Bridge.—The City Engineer of Minneapolis, Minn., has been authorized to advertise for proposals for the construction of the substructure of the new Franklin avenue bridge.

Grading.—On a large number of streets. The Board of Public Works, St. Paul, Minn. January 24.

Buildings.—At Fort Bridger, Wyo. Stone, or frame on stone foundations. J. B. Dandy, Chief Quartermaster, Headquarters, Department of the Platte, Omaha, Neb. February 1.

Ferry-boat.—For the East Boston ferries. A. C. Whitney, Boston, Mass. February 1.

Churches.—Separate bids for carpenter work, galvanized-iron work, cut stone, and brick work. F. Mahoney, Secretary of the Building Committee of St. Mary's Church, Delaware, O. February 2.

Construction complete of the German Evangelical Church. A. B. Alger, architect, Portsmouth, O. February 10.

Pump House, Tank and Pump.—Boiler and pump house, cypress tank and trestle, steam pump and boiler for deep well, 1,766 feet of water mains. Capt. J. W Jacobs, U. S. A., Assistant Quartermaster, Atlanta, Ga. February 14.

Removing Wrecks.—From Patapsco river. Lieut. Col. W. P. Craighill, U. S. Engineer Office, Baltimore, Md. February 15.

New Croton Aqueduct.—The following bids were opened by the Aqueduct Commissioners on January 19, 1886, for the construction of the new Gate House at 135th street, New York City: The Commissioners will consider the proposals and award the contracts to-day.

Name.	Earth Excava 2,000 cub yds.	Rock Excava. 9,000 cub. yds.	Soiling, 300 cubic yards.	Refilling, 5,000 cub. yds.	Brick Masonry, 1000 cub. yds.	Face Brick Ma onry, 80 cub. yds.	Concrete Masonry,(5 stone 1 cement) 100 cub yds.	Concrete Masonry,(3 stone 1 cement) 50 cub. yds.	Rubble Masonry, 3,00 cu yds.	Cut Paving, 80 cub. yds.	Cut Facing—Stone Masonry, 750 cub. yds.	Granite Dimension Stone Masonry, (1,500 cub. yds.)	Rock Face Dimension Stone Masonry, (250 cub. yds.)	Ashlar Masonry, (200 cub. yds.)	Rough Pol'ted Dress'g (20,000 sqa. ft.)	Hammer Face (Six Cut) Face Dress'g, (14,000 sqa. ft.)	Masonry, (Ad d'l for Port. Cem't. mort.) (1,000 cub. yds.)	Masonry. (Ad d'l for Amer'n. Cem't Mort.) (1,000 cub. yds.)	Wrought-Iron, Placed (50 tons)	Hub & Spigot Pipe, 48 in and under, (35 tons)	Cast-Iron Specials (75 tons).	Slate Roof (43 squares.)	Copper, Gutters and Flashings, (500 sq. ft)	Yellow Pine Match Boards (6,000 sq. ft. B. M)	Total.
Paige & Carey..	30	3.00	30	.20	11 00	40.00	4.00	5.00	6.00	20.00	30.00	25.00	23.00	16.00	50	.80	1.50	1.50	70.00	80.00	80.00	30.00	30	60	168,850.00
John Pierce....	1.00	3.00	1.00	.50	11.00	35.00	6.00	7.00	4.50	20.34	25.97	31.49	28.34	34.34	35	.85	.75	.75	90.00	35.00	80.00	10.00	25	40	173,904.20
Smith & Brown	1.00	3.20	1.00	.45	12.00	36.00	3.60	5.40	5.40	12.00	18.00	53.00	18.00	17.00	21	.45	1.50	.45	90.0	54.00	67.00	10.00	90	90	191,531.00
R. A. Malone...	80	2.80	80	.80	12.00	28.00	6.00	7.00	7.00	18.00	18.00	32.00	20.00	23.00	30	.80	1.00	.75	95 00	45.00	60.00	18 00	30	60	169,929.00
Charles Brown.	42	2.00	75	.45	12.00	17.00	5.00	7.00	18.00	10.00	15.00	26.00	13.00	11.00	60	.90	3.00	2.50	65.00	45.00	75.00	6.00	60	50	156,733.00
John Cox & Co..	45	2.08	50	.30	13.00	45.75	5.19	6.00	5.00	9.00	27.45	55.00	40.00	49.00	60	.60	1.40	.75	140 00	78.00	100.00	14.00	35	150	217,381.00
Chas. Guidet....	90	5.00	75	.45	18.00	75.00	10.50	15 00	6.75	46.29	67.12	62.07	59.62	81.90	90	1.87	1.95	.94	193.50	138.49	196.50	21.00	67	163	348,852.85
John McNamee	35	2.00	60	.50	11.50	35.00	6.00	6.50	5.00	25.00	31.00	35.00	33.00	33.00	75	1.50	1.00	.75	160.00	60.00	40.00	15.00	27	90	199,963.00

Contracting.

Levee Work.—The Board of State Engineers of Louisiana, at New Orleans, has awarded the contract for the Raleigh levee extension to Geo. Arnold & Co., of New Orleans, at 11 cents per cubic yard.

Sewer.—The following proposals have been received for arching the town branch at Little Rock, Ark.: P Powers, $2,850; J. Collamore, $3,800; H. Grant, $2.95; P. Knowles, $3.25; J. M. Brown, $3.75. The contract was awarded to P. Powers.

Building Repairs.—The following proposals have been received for repairs, alterations and construction at the Truant Home, Brooklyn, N. Y.: Robert J. Brown, $11,200; F. J. Kelly, $12,349; Leonard Bros., $14,435; John H. O'Rourke, $14,850.

Street Railroad.—The street railroad at Lockport, N. Y., was formally opened January 1st, and is giving general satisfaction. It was constructed by T. William Harris, contracting engineer for public works, 19 Exchange place, Boston, Mass.

Bridges.—P. E. Lane, C. E., 29-177 La Salle street, Chicago, has recently been awarded the contracts for the following bridges: Iron bridge at Forest, Ill., single span, cost $4,000; Soldier's Grove, Wis., iron bridge single span $2,100; iron bridge at Garnett, Ill., 70 feet span, cost $1,600; Hobart, Ind., iron bridge, cost $2,000.

Locomotives and Cars.—The Atchison, Topeka & Santa Fé R. R. Co. has let contracts for 4,800 freight cars and will let contracts at once for 140 locomotives 80 sleeping cars and a large number of passenger cars. All this rolling stock is for the new Chicago and Kansas City line.

City Work.—Jackson avenue, from Long Island City to Flushing, L. I., is to be macadamized. The cost will be $30,000, apportioned as follows: Newtown, $12,000; Flushing, $8,000; North Hempstead, $10,000.

At Philadelphia ordinances have been passed for the construction of a large number of sewers.

At Omaha, Neb., a considerable amount of street improvements will be done this year.

Cement Imported into the United States in 1886.—Carefully kept returns show the following amounts of hydraulic cement imported into the United States in 1886, from the several shipping points named: Antwerp, 31,149 barrels; Amsterdam, 2,468; Bremen, 68,055; Glasgow, 530; Hamburg, 84,746; Marseilles, 2,570; Newcastle, 7,160; Stettin, 41,379; London, 243,822, and Rotterdam, 31,430. The total is 513,309 barrels.

Bridge.—The following proposals were opened January 20th, for the iron bridge at Albany street, Boston, Mass.: New Jersey Steel & Iron Works, $11,300; King Iron Bridge & Manufacturing Co., Cleveland, O., $11,338; Cofrode & Saylor, Philadelphia, Pa., $11,450; Penn Bridge Co., Beaver Falls, Pa., $11,500; Boston Bridge Works, $11,990. The contracts were not awarded.

Union Pacific R. R.—Work is progressing rapidly on the construction of the Union Pacific & Western Colorado R. R. in Wyoming, south from Fort Steel. The line follows the North Platte river up into the North Park. The road bed complete, and ready for track will cost the low sum of $5,000 per mile. During this year 100 miles of track will be laid; 30 miles are now under construction by Kilpatrick Bros. & Collins, who have sublet the work at following prices: solid rock (sandstone), $1; loose rock, 50 cents; earth, 15 cents. Labor and supplies cost as follows: teams, $4 per day; laborers, $2; hay, $20 per ton; oats, 60 cents per bushel; lumber for shanties, $22 per M. About half the work is side hill rock work, and the balance is earth work across dry gravelly and sandy bottoms. The balance of the work will be let during March. The maximum curvature is 10°, and the maximum grade 26.40 (.05 per cent.) per mile. J. W. Collins is Division Engineer; Albert Lewis, R. Webster and E. M. Rochbough, Sub Division Engineers.

Cruiser.—The Secretary of the Navy will readvertise for proposals for the construction and equipment of cruiser No. 1 (the *Newark*) and will be authorized to accept a bid not exceeding $1,300,000.

Lumber.—The following proposals have been received by the Board of Public Improvements, Cleveland, O., for 830,000 feet B. M. of southern pine: W. I. Lindsay & Co., $29.75; Carpenter & Jewett, $29.98; A. Teachout, $32; Norwood & Butterfield, $32.60; Pack, Woods & Co., $33.50. The contract was awarded to W. I Lindsay & Co.

Ditch.—The contract for dredging one of the branches of the Lake Fork ditch, in Piatt county, Ill., was recently awarded to Pollard, Goff & Co., contractors for the main stem, at 9.75 cents; the price for the main stem was 13 cents. The Danforth Gilman-Onarga ditch contract (recently advertised in our columns) was let to a firm at Crawfordsville, Ind., at 10.5 cents; there were eleven bidders for this work and the highest bid was 18 cents.

The Hyatt Water Filter.—The Newark Filtering Co., of Newark, N. J., has a contract to furnish a firm at Holyoke, Mass., with a plant of 1,300,000 gallons daily capacity. The Hudson River Paper & Power Co. has a plant of similar capacity for its mills at Mechanicville, N. Y., and the Hampshire & Carew paper mills, South Hadley Falls, Mass., have a plant of 400,000 gallons daily capacity.

Water Pipe, Etc.—The following proposals have been received by the Water Commissioners of Minneapolis, Minn., for supplies for the extensions of the water supply system: *Pipe* (6, 8, 10, 12, 16 and 24-inch), Dennis Long & Co., Louisville, Ky., $36.25; Shickle, Harrison & Howard Co., St. Louis, Mo., $36.90; Cincinnati & Newport Iron & Pipe Co., Newport, Ky., $36.94; McNeal Pipe & Foundry Co., Burlington, N. J., $38.50.

Hydrants.—(400), Eddy Valve Co., Waterford, N. Y., $27.50; Holly Manufacturing Co., New York City, $31; Holyoke Manufacturing Co., $34.79; National Tube Works, Chicago, $35; R. D. Wood & Co., Philadelphia, Pa., $36.50; Coffin Valve Co., Boston, Mass., $37; Addinter & Killops, Chicago, Ill., $39; James Flower & Bros., Detroit, Mich., $39.52; Lockwood, Upton & Co., Minneapolis, $39.90; Galvin Brass & Iron Works, Chicago, $40; Holland & Thompson Manufacturing Co., St. Paul, Minn., $45.11; Chapman Valve Manufacturing Co., Minneapolis, $45.11; Ball & Naylor, Minneapolis, $52; Fulton Iron Works, St. Louis, Mo., $68.50. All bids were rejected

Gates.—(6, 8, 10, 12, 16 and 24-inch), Holland & Thompson Manufacturing Co., St. Paul, $10, $16.25, $21.12, $31.50, $52.50, $145; Addinter & Killops, Chicago, $11.40, $16,80, $25,95, $37, $75, $235; Peet Valve Co., Boston, $11,50, $19, $25,50, $36, $70, $170.75; Rensellaer Manufacturing Co., New York City, $12.48, $18.88, $26.95, $34.99, $72.44, no bid; Ripley, Kimball & Co., $12.50, $17.50, $28.25, $37, $77, $190; Galvin Brass & Iron Works, Chicago, $12.50, $20.75, $30 $40, $76, $200; James Fowler & Bros., Detroit, $12 60' $19.05, $27.50, $38.40 $69.50, $214.40; Ball & Naylor, Minneapolis, $12.75, $19.25, $29, $37, $75, $200; Coffin Valve Co., Boston, $13.15, $19.25, $26.75, $35, $70, $216; National Tube Works, Chicago, $13.47, $20.13, $27.99, $36,60, $70,14, $149.33; R. D. Wood & Co., Philadelphia, $13.70, $19.90, $28.10, 97, $75, $.05; Chapman Valve Co., Minneapolis, $14.41, $21.39, $32.57, $44.20, $76.80, $200; Eddy Valve Co., Waterford, N. Y., $15,50, $22.05, $29.35, $39,20, $73.50, $197; Whittier Machine Co., Boston, $17.89, $24.43, $39.01, $49.04, $93.54, $223.50; Fulton Iron Works, St. Louis, $18.50, $30, $49, $78,50, $130, $315.

Sewers.—The following proposals were opened January 17th for the construction of sewers at Portchester, N. Y.: F. H. Merritt, Westchester avenue section, $24,637.86; Highland avenue section, $6,739.75; total, $31,377.61. Sherman & McDonough, $25,800, $6,000; $31,800. F. Leonard, $24,000, $8,000; $32,000. Austin Brothers, $23,953.20, $8,568.60; $32,521.80. Daniel Murray, $25,003.80 $7,955; $32,958.80. The lowest bid for the entire work was that of F. H. Merritt, $31,377.61; the lowest by sections was Austin Brothers (Westchester avenue), $23,953.20; Sherman & McDonough (Highland avenue), $6,000; total, $29,953.20. The awards are not yet made.

Jail.—The following proposals have been received at the Office of the Supervising Architect, Washington, D. C., for constructing a jail at Fort Smith, Ark.: Larkworthy & Menke, $58,403; James H. Coster, $57,950; Holtzclaw Bros., $54,401; Champion Iron Fence Co., $49,885; McCarthy & Corbett, $47,969; J. M. Brown, $47,800; Pauly Jail Building & Manufacturing Co. (steel sample A) $40,123, (steel sample B) $39,691, (steel sample C) $39,255; if Springfield stone No. 3 is used throughout, add $1,500; ditto except footings, add $1,000; if No. 2 brick are substituted for No 3 for facing, deduct $700; if concrete footings are reduced in width deduct, $250; if brick No. 2 are substituted for stone footings, deduct $400. The contract has been awarded to the Pauly Jail Building & Manufacturing Co.

Dock.—The following proposals have been received for repairing the 30th street dock, at Bayonne, N. J.: James J. Cogan, Bergen Point, N. J., $7,323.28; Moses Engel, Brooklyn, N. Y., $9,315.40; James D. Leary, New York City, $11,076,67; Thomas Henry, Bayonne, $15,633,30. The contract was awarded to James J. Cogan.

Masonry.—The following proposals have been received at the Office of the Supervising Architect, Washington, D. C., for masonry for the court-house at New Albany, Ind.: Anderson Brothers, (blue Amherst) $27,814, (buff Amherst) $28,219, (Bedford) $31,114; Wm. S. Burns, (blue Amherst) $29,989, (buff Amherst) $31,800; Doerschbach & Decker, (Berea) $30,401, (buff Amherst) $33,366; Crumbs & Melcher, (Bedford) $31,700, (Salem) $32,000; Terre Haute Stone Works, (Stinesville) $32,324; Dumesnil Brothers, (Bedford) $33,200; Rice & Bassett, (blue Amherst) $34,465, (buff Amherst) $35,802, (Bedford) $37,545.61; Peter & Melcher Stone Works, (Bedford) $35,675; E. S. Gobel, (blue Amherst) $39,937, (Bedford) $43,184.40; Blake & Krebs, (Bedford) $41,649; James H. Coster, (Salem) $52,256. The contract was awarded to Anderson Brothers.

Bridges.—The following proposals for bridge work have been received at St. Louis, Mo.: (1). For the iron work of the north viaduct of the Grand avenue bridge, between the north anchor pier and north approach; Wrought Iron Bridge Co., $16,700; H. S. Hopkins Bridge Co., $16 960; Wm. McCully, $17,887; St. Louis Bridge & Iron Co., $19,000; New Jersey Steel & Iron Co., $20,300. The contract was awarded to the Wrought Iron Bridge Co. —(2). For removing present wooden superstructure of Bircher street bridge and putting up iron superstructure; Stupp Bros., superstructure, $770; masonry $6.75 per cubic yard, $101.25; coping, $1.25 per yard, $93.75; total, $965. Wrought Iron Bridge Co., superstructure, $825; masonry, $10, $150; coping, $1, $75; total, $1,050. Wm. McCully, superstructure, $886; masonry, $7, $105; coping, $1, $75; total, $1,066. St. Louis Bridge & Iron Co., superstructure, $950; masonry, $7.50, $112.50; coping, $1.25, $93.75; total, $1,156.25. The contract was awarded to Stupp Bros.—(3). For constructing the foundation piers of the viaducts between the anchor piers and approaches of the Grand avenue bridge. John Bambrick, excavation, 29 cents, $1,160; concrete, $4.25, $743.75; coursed masonry, $6.55, $556.75; dimension stone, $23,30, $815.50; iron work, $125; total, $3,401. Wm. McCully, excavation, 30 cents, $1,200; concrete, $4.50, $787.50; coursed masonry, $8,$680; dimension stone, $25, $875; iron work, $150; total, $3,692,50. Edward Reilly, excavation, 30 cents, $1,200; concrete, $4.25, $743.75; coursed masonry, $8, $680; dimension stone, $29, $1,015; iron work, $150, total, $3,788.75. John Hill, excavation, 23 cents, $920; concrete, $5, $875; coursed masonry, $12.50, $1,062.50; dimension stone, $23.75, $831.25; iron work, $125; total, $3,813.75. Christ, Pieper & Co., excavation, 40 cents, $1,600; concrete, $4, $700; coursed masonry, $10, $850; dimension stone, $25, $875; iron work, $160; total, $4,125. The contract was awarded to John Bambric .